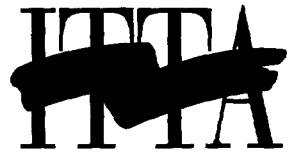

INDEPENDENT
TELEPHONE & TELECOMMUNICATIONS
ALLIANCE

November 9, 1998

Ms. Magalie Roman Salas
Secretary
Federal Communications Commission
1919 M Street, N.W., Room 222
Washington, D.C. 20554

Re: **In the Matter of Access Charge Reform, Price Cap Performance Review for Local Exchange Carriers, and MCI Telecommunications Corporation Emergency Petition for Prescription, CC Docket No. 96-262, 94-1, and RM-9210**

Dear Ms. Salas:

This letter is to advise you that the Independent Telephone and Telecommunications Alliance (ITTA) is submitting the attached Reply Comments in the above-referenced proceedings. One original and nine copies of the Reply Comments are attached for filing with your office in accordance with the Commission's rules. An additional copy is also attached for filing with the International Transcription Services (ITS).

Please contact me if you have any questions regarding this matter.

Respectfully submitted,

David W. Zesiger
Executive Director

Enclosures

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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matters of	)	
	)	
Access Charge Reform	)	CC Docket No. 96-262
	)	
	)	
Price Cap Performance Review For Local Exchange Carriers	)	CC Docket No. 94-1
	)	
	)	
MCI Telecommunications Corporation Emergency Petition for Prescription of Access Charges	)	CC Docket No. 97-250
	)	
	)	
Consumer Federation of America Petition for Rulemaking	)	RM 9210
	)	

REPLY OF
THE INDEPENDENT TELEPHONE & TELECOMMUNICATIONS ALLIANCE

On multiple occasions over the past year, the Commission, in individual speeches[1] and collective formal pronouncements,[2] has observed that midsize companies are not like large LECs. On behalf of its price cap regulated members, the Independent Telephone & Telecommunications Alliance (ITTA) asks the Commission to act on these observations in two affirmative ways. First, the Commission should recognize the evidence of record submitted in this proceeding and others by Aliant Communications,

[1] See, e.g., "Working Toward Independents' Day: Mid-Size Carriers as the Special Forces of Deregulation," Remarks by Michael K. Powell, Commissioner, Federal Communications Commission, before the Independent Telephone Pioneer Association, Washington, D.C. (May 7 1998) (as prepared for delivery).

[2] See, e.g., *In the Matter of Performance Measurements and Reporting Requirements for Operations Support Systems, Interconnection, and Operator Services and Directory Assistance*, FCC CC Docket No. 98-56, RM-9101, released April 17, 1998, at paras. 21, 131.

Cincinnati Bell Telephone Company, and Citizens Utilities and adopt a separate X-factor for these midsize elective price cap companies.[3] Second, the Commission should acknowledge that it cannot achieve its goal of a deregulated future through regulation and therefore should refuse to initiate further prescriptive proceedings concerning midsize company access charges.

1. Factual differences warrant a factually different X-factor.

As the initial Comments of Cincinnati Bell Telephone Company (CBT) in this matter reflect,[4] on May 14, 1998, ITTA filed with the Commission data and analysis on midsize X-Factors performed by Strategic Policy Research, Inc.[5] SPR's study examined productivity and related information for two midsize companies – Aliant Communications (Aliant) and CBT – utilizing the FCC's own methodology with only minor adjustments.[6] That study demonstrated "that Cincinnati Bell and Aliant have had slower productivity growth than the RBOCs" as a historical matter, thereby undermining the notion that (unlike the BOCs) they would have greater prospects for productivity growth in the future.[7] SPR determined that, far from poor performance, such diminished growth resulted from lower unit costs (compared to larger LECs) which leave midsize companies with less room for equivalent percentage productivity gains in the future.

[3] See Attachment A for a listing of prior midsize price cap company advocacy in this docket since the issuance of the Commission's May 1997 order.
[4] See "Comments of Cincinnati Bell Telephone Company," filed in these dockets on October 26, 1998, at 2.
[5] See Attachment B, letter from David W. Zesiger, Executive Director, ITTA, to Magalie Roman Salas, Secretary, Federal Communications Commission, May 14, 1998.
[6] Rohlfs, J. and Pehrsson, K., "One Size Does Not Fit All: Further Evidence Against the Adequacy of a Single X-Factor," Strategic Policy Research, Inc. (Bethesda, Maryland April 1998) at 6 ("SPR Study").
[7] SPR Study at 9, 10.

These conclusions, statistically sound, comport with common sense. There is no particular reason to suppose, *a priori*, that all telephone companies are the same. ITTA has repeatedly drawn the Commission's attention to the separate discussion and treatment afforded midsize companies by Congress in the 1996 Telecommunications Act. Certain Members of Congress have amplified this policy distinction in recent correspondence with the Commission.[8] The Commission itself has begun to acknowledge the need for different policies for midsize companies.[9] In the present matter, the SPR Study reinforces the need for differential treatment in the case of X-factor development:

> A variform approach to price caps is desirable because price-cap LECs are so diverse. At one extreme are urban companies, such as Cincinnati Bell. At the other extreme are companies which serve entirely rural companies. All these companies are very different from the Regional Bell Operating Companies (RBOCs). Each RBOC is 10 times as large as the smaller companies and each serves diverse areas, including urban and rural communities. Conceivably, the BOCs are sufficiently homogeneous that a single X-Factor is appropriate for all of them. However, it would be an amazing coincidence if that same X-Factor were also appropriate for Cincinnati Bell and Aliant, as well as companies which serve entirely rural communities. We demonstrate in this paper that there is, in fact, no such coincidence.[10]

Midsize companies aren't the same as BOCs. No evidence in the FCC's possession demonstrates the contrary.

In terms of continuing to ignore this fundamental fact, the Commission's choices would seem to be limited. Disregarding this data, as the Commission has done to date, can lead to an arbitrary and capricious (and therefore unsustainable) ruling. Mulching midsize company data with that of the BOCs is not an alternative remedy. The

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[8] See Attachment C, letter from Reps. John Boehner, Mike Oxley, *et. al.*, to Chairman William E. Kennard dated August 6, 1998.

[9] See, e.g., *1998 Biennial Regulatory Review – Review of Depreciation Requirements for Local Exchange Carriers*, FCC CC Docket No. 98-137, *Notice of Proposed Rulemaking*, FCC 98-170 (October 14, 1998)("Depreciation Notice").

Commission has often observed that the BOCs and GTE account for 90 – 92% of the nation's access lines.[11] Incorporation of midsize data representing roughly 5%-6% of access lines merely results in dilution, not in recognition of meaningful policy distinctions. The Commission should do here what it has talked about doing elsewhere: it should recognize that the evidence does not support a collectivized, unitary solution to productivity analysis. Midsize companies require and have justified separate X-Factor treatment.[12]

2. The FCC cannot prescribe its way to deregulation.

Prescription is an act of regulation. It increases the regulatory burden on those subject to the rules prescribed. If the Commission truly seeks ways to "implement specific forms of pricing flexibility for LECs" it should not undertake interstate access rate prescription. Rather, the Commission should start by de-prescribing rules and requirements no longer used and useful in promoting competition and deregulation.

Examples of opportunities for such deregulation are not hard to come by. CBT and Citizens petitioned for reconsideration of the present X-Factor decisions more than a year ago, without decision by the Commission.[13] Last February, ITTA filed a relatively limited Petition for Forbearance that identified less than a dozen specific areas where

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[10] SPR Study at 2.
[11] See Depreciation Notice, supra, at para. 17.
[12] Midsize company efforts to justify separate X-Factor treatment precede the current dockets. Attachments D and E are studies from 1989 and 1991, respectively, that were previously undertaken by National Economic Research Associates, Inc. (NERA) to demonstrate the need for a separate midsize X-Factor.
[13] CBT Petition for Reconsideration filed July 11, 1997 *In the Matter of Price Cap Performance Review for Local Exchange Carriers*, FCC CC Docket No. 94-1, *Fourth Report and Order*; Petition for Reconsideration of Fourth Report and Order in CC Docket No. 94-1 and Second Report and Order in CC Docket No. 96-262 (filed by Citizens Utilities Company, July 11, 1997).

immediate deregulation was warranted.[14] The pleading process concluded some months ago, but no action has resulted. The Anchorage Telephone Utility sought critical pricing flexibility in a waiver application in July.[15] No response has materialized. Even with its obvious good faith and positive intentions, the Commission cannot act and react as rapidly as a market mechanism. No regulatory agency can, because such agencies were not designed for that purpose. Prescription, being an act of regulation, exacerbates rather than cures this inherent shortcoming.

In the matter of access charges, what the Commission should "prescribe" is pricing flexibility. It should proceed to develop and implement policies that begin the deconstruction of rigid regulation by recognizing the need for service and market responsiveness. Instead of adopting surrogates for the marketplace, it should allow midsize companies to act flexibly in response to developments in that marketplace. Nowhere is this more important than in the terms and the pricing of services to the consumer.

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[14] *In the Matter of the Petition for Forbearance for 2% Mid-Size Local Exchange Companies*, Petition for Forbearance of the Independent Telephone & Telecommunications Alliance, AAD 98-43 (filed February 17, 1998), and Reply Comments of the Independent Telephone & Telecommunications Alliance (filed May 18, 1998).

[15] *In the Matter of ATU Telecommunications Request for Waiver of Sections 69.106(b) and 69.124(b)(1) of the Commission's Rules*, Waiver Request, CCB/CPD 98-40 (filed June 22, 1998).

In the 1996 Act, Congress specifically recognized the congruence of competition and deregulation. Without the latter, the former will never develop on a full, fair, and sustainable basis. Yet Commission efforts to date have been imbalanced, with deregulation taking a distinct second seat to "pro-competitive" regulation. The approach of the third anniversary of the 1996 Act heightens the need for the Commission to rebalance its efforts by undertaking specific, concrete deregulatory initiatives. Recognition of separate X-Factors and pricing flexibility for midsize companies would be a good start.

Respectfully Submitted,

THE INDEPENDENT TELEPHONE & TELECOMMUNICATIONS ALLIANCE

By: _____
David W. Zesiger, Executive Director

By: _____
Donn T. Wonnell, *Counsel for*

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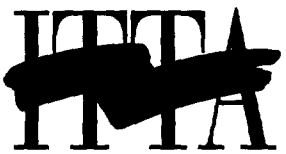
November 9, 1998



INDEPENDENT
TELEPHONE & TELECOMMUNICATIONS
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Midsize Companies Price Cap Advocacy in CCD 94-1, CCD 96-262

CUC Petition for Reconsideration, CC dkt. No. 94-1, CC dkt. No. 96-262 (filed July 11, 1997).

CBT Petition for Reconsideration, CC dkt. No. 94-1 (filed July 11, 1997).

CUC Emergency Petition for Waiver, CC dkt. No. 94-1, CC dkt. No. 96-262 (filed July 14, 1997).

SNET Petition for Waiver, CC dkt. No. 94-1, (filed August 13, 1997).

SNET Comments on Petitions for Reconsideration, CC dkt. No. 94-1, CC dkt. No. 96-262 (filed August 1997).

SNET Opposition, CC dkt. No. 94-1, CC dkt. No. 96-262 (filed August 18, 1997).

ITTA Comments, CC dkt. No. 94-1, CC dkt. No. 96-262 (filed August 18, 1997).

ITTA Reply Comments, CC dkt. No. 94-1, CC dkt. No. 96-262 (filed September 3, 1997).

CBT Reply Comments, CC dkt. No. 94-1, CC dkt. No. 96-262 (filed September 3, 1997).

SNET *Ex Parte* Presentation, CC dkt. No. 94-1 (filed September 15, 1997).

SNET *Ex Parte* Presentation, CC dkt. No. 94-1 (filed September 22, 1997).

ITTA *Ex Parte* Presentation, CC dkt. No. 94-1 (filed April 23, 1998).

ITTA *Ex Parte* Presentation, CC dkt. No. 94-1 (filed May 14, 1998), including One Size Does Not Fit All, Further Evidence Against the Adequacy of a Single X-Factor by Jeffrey H. Rohlfs, Kirsten Pehrsson of Strategic Policy Research, Inc.

ITTA Initial Brief, USTA v. FCC, No. 97-1469 (D.C. Circuit) (filed May 15, 1998).

ITTA *Ex Parte* Presentation, CC dkt. No. 94-1 (filed June 2, 1998).

ITTA *Ex Parte* Presentation, CC dkt. No. 94-1 (filed June 3, 1998).

ITTA Reply Brief, USTA v. FCC, No. 97-1469 (D.C. Circuit) (filed July 15, 1998).

ITTA Erratum, USTA v. FCC, No. 97-1469 (D.C. Circuit) (filed July 16, 1998).

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ITTA Erratum, USTA v. FCC, No. 97-1469 (D.C. Circuit) (filed July 16, 1998).

ITTA *Ex Parte* Strategic Policy Research Study, (filed May 14, 1998).

Congressional Correspondence to the Commission regarding Mid-size Price Productivity X-factor, dated (August 6, 1998), signed by John Boehner, Ted Strickland, Rick Boucher, Tom Sawyer, Steve Chabot, Michael G. Oxley, Rob Portman, Paul Gillmor, Sherrod Brown.

ATTACHMENT B

INDEPENDENT
TELEPHONE & TELECOMMUNICATIONS
ALLIANCE

May 14, 1998

Ms. Magalie Roman Salas
Secretary
Federal Communications Commission
1919 M St., N.W. Room 222
Washington, D.C. 20554

Ex Parte: Price Cap Performance for Local Exchange Carriers
CC Docket No. 94-1

Dear Ms. Salas:

On July 11, 1997, Cincinnati Bell Telephone Company (CBT) and Citizens Utilities Company (Citizens), both Independent Telephone & Telecommunications Alliance members and 2% mid-size LECs, filed individual Petitions for Reconsideration (PFR) in CC Docket No. 94-1, Price Cap Performance Review for Local Exchange Carriers. Both PFRs specifically addressed the inappropriateness of applying the Commission's single 6.5% X-Factor to all Price Cap LECs.

CBT's PFR provided an empirical study, using CBT data and the Commission's TFP methodology (neither ITTA nor its members endorse this method), that provided the Commission with the following factual basis:

1. The 6.5% X-Factor is not appropriate for CBT. The specific data resulted in an annual TFP differential of 2.8% annually over the 1991 – 1995 time period; and

2. The study continues to support earlier Commission conclusions in CC Docket 87-313 that mid-size LECs cannot achieve, and should not be held, to the same level of productivity growth as the RBOCs. This study established that a 1.5% annual difference existed between CBT's and the RBOC average productivity growth rates.

Based on this uncontradicted evidence, CBT petitioned the Commissions to reconsider its decision to establish a single 6.5% X-Factor for all LECs and asked that a separate study be performed using non-RBOC data.

Ten months have passed since CBT filed its PFR. During that time the Commission Staff has given no indication of when it will consider, let alone make a recommendation to the Commission to act on CBT's petition. Given this significant delay, ITTA, on behalf of its price

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cap companies, urges the Commission to move this issue forward. In addition, ITTA hereby submits an updated version of the study in further support of CBT's pending PFR. This study has been expanded to include the data for Aliant Communications. The findings, enhanced with the inclusion of the Aliant data, continue to support the earlier conclusions that the 6.5% X-Factor is inappropriate for 2% mid-size LECs and that a significant difference exists between the productivity growth rates for the RBOCs and 2% mid-size LECs. This study has already been informally reviewed with several of the Commissioners' Legal Advisors and Staff from the Competitive Pricing Division (see ITTA Ex Parte Letter, CC Docket No. 94-1, dated April 23, 1998) and is now being formally submitted as indicated in those ex parte visits.

Based on the facts presented in earlier PFRs, the empirical data set forth in CBT's PFR and supplemented here, ITTA strongly believes that the Commission has sufficient evidence to order a lower X-Factor for 2% mid-size price cap LECs. ITTA proposes the following recommendation for Commission action:

1. The Commission should immediately establish an interim X-Factor of 5.0%. This recommendation is supported by the 1.0% – 1.5% differential in productivity growth that the empirical data illustrates between 2% mid-size LECs and RBOCs;

2. The Commission should allow an exogenous adjustment to reflect that this new X-Factor should have been allowed at the time 2% mid-size companies were mandated to implement the 6.5% X-Factor; and

3. In the next Price Cap review, the FCC should complete an X-Factor analysis based on data from 2% mid-size companies that shall be used in future filings.

Given the limited time for consideration of this request before rates must be finalized for the July 1, 1998 Annual Price Cap filing, ITTA urges that the Commission act expeditiously on this request. Please feel free to contact me if you have any questions.

Very truly yours,

David W. Zesiger

David W. Zesiger

cc: Katie King
Paul Gallant
Jim Casserly
Kyle Dixon
Tom Power
Kevin Martin
Jane Jackson

Attachment (1)

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One Size Does Not Fit All:
Further Evidence Against the Adequacy of a Single X-Factor

Jeffrey H Rohlfs
Kirsten M. Pehrsson[1]

April 23, 1998

The Federal Communications Commission (FCC), in its *Fourth Report and Order*,[2] decided to use a single X-Factor for all price-cap local exchange carriers (LECs). Last summer, we responded with a paper arguing that using a single X-Factor is inequitable and does not capture the inherent difference between RBOCs and smaller companies like Cincinnati Bell Telephone and Aliant.[3] We specifically respond to the FCC's evidence justifying a single X-Factor. In particular, we presented specific evidence that the FCC's X-Factor was inappropriate for Cincinnati Bell. In this paper, we are able to buttress our earlier findings by broadening the analysis to include another mid-sized company — Aliant. Including an additional company in the analysis affords the

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[1] Dr. Rohlfs is a principal in Strategic Policy Research, Inc., an economics and telecommunications policy consulting firm located in Bethesda, Maryland. He formerly served as Head of Economic Modeling Research at Bell Labs. Ms. Pehrsson is a Senior Consultant at SPR.

[2] FCC, In the Matter of Price Cap Performance Review for Local Exchange Carriers, Access Charge Reform, *Fourth Report and Order in CC Docket No. 94-1 and Second Report and Order in CC Docket No. 96-262*, CC Docket No. 94-1 and CC Docket No. 96-262, adopted May 7, 1997, released May 21, 1997.

[3] Jeffrey H. Rohlfs and Kirsten M. Pehrsson, *One Size Does Not Fit All: The Inadequacy of a Single X-Factor for All Price-Cap Companies*, submitted before the Federal Communications Commission, *In the Matter of Price Cap Performance Review for Local Exchange Carriers; Access Charge Reform*, CC Docket Nos. 94-1 and 96-262, Attachment to Petition for Reconsideration, July 11, 1997.

opportunity for sensitivity analyses that prove our estimates to be robust. It also reveals Aliant results that are consistent with those for Cincinnati Bell.

Interim Plan Versus New Plan

Under the FCC's interim price-cap plan, LECs had a choice of X-Factors. LECs which chose the highest X-Factor were exempt from any sharing of earnings. LECs which chose a lower X-Factor incurred obligations to share earnings above certain prespecified levels.

A drawback to this approach is that sharing dilutes the incentives of LECs to improve efficiency. In general, one would expect LECs that operate under sharing regimes to be less efficient in the long run than similar companies operating under pure price caps. For this reason, the FCC abandoned the interim approach in favor of a pure price-cap plan.

We certainly do not criticize the FCC's decision to eliminate sharing. Nevertheless, the interim plan did have the advantage of distinguishing among LECs. It did not envision that one size of price-cap plan fits all companies.

A variform approach to price caps is desirable because price-cap LECs are so diverse. At one extreme are urban companies, such as Cincinnati Bell. At the other extreme are companies which serve entirely rural communities. All these companies are very different from the Regional Bell Operating Companies (RBOCs). Each RBOC is 10 times as large as the smaller companies and each serves diverse areas, including urban and rural communities. Conceivably, the RBOCs are sufficiently homogeneous that a single X-Factor is appropriate for all of them. However, it would be an amazing coincidence if that same X-Factor were also appropriate for Cincinnati Bell and Aliant, as well as companies which serve entirely rural communities. We demonstrate in this paper that there is, in fact, no such coincidence.

The FCC's new price-cap plan should take account of differences among price-cap LECs. It need not give companies a choice of X-Factors (in exchange for differential sharing obligations). It could instead have different X-Factors for companies with different prospects for productivity growth. We discuss below how multiple X-Factors can be used without diluting efficiency incentives.

Response to the FCC's Evidence

In the *Fourth Report and Order*, the FCC adduces a variety of evidence to justify its decision to use a single X-Factor. In this section, we respond to that evidence.

Court Cases

The FCC cites court cases to demonstrate that using a single cost standard is not "inherently" unreasonable.[4] To be sure, a single standard might be the only practical alternative under some circumstances; *e.g.*, if the regulatory body has minimal staff and/or cost data are lacking. However, these considerations obviously do not apply to the FCC.

Indeed, the FCC staff has already developed a computer model of productivity growth. The model that the FCC has disclosed is populated with RBOC data. However, the same model could easily have been populated with data from other LECs.[5] We were able to populate the model with Cincinnati Bell and Aliant data in a few days' time. The FCC could certainly have done likewise.[6] One would certainly have expected that members of the Commission staff would already have populated the model with data from LECs other than RBOCs in order to observe the results. Yet, no results of applying the model to non-RBOC data were discussed in the *Fourth Report and Order*.

Reference to Corrected Norsworthy Model

In justifying the use of a single X-Factor, the FCC does not refer to its own model. Instead, it refers to the Norsworthy model, as corrected by Christensen.[7] The corrected Norsworthy model yields estimates of productivity growth between 2.9 percent per year and 3.1 percent per year. It is hard to see how these estimates can possibly justify setting an X-Factor of 6.5 percent per year for all price-cap LECs.

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[4] *Ibid.*, ¶ 160.

[5] Data from some companies will undoubtedly be incomplete and/or have data problems. Nevertheless, sufficient data are probably available in every case to draw valid inferences about differences in productivity.

[6] Moreover, our task was made more difficult, because the Commission altered its spreadsheet (159chrts.xls) to substitute values for the underlying formulae. We therefore had to take time to reconstruct the formulae. The Commission can use its unaltered spreadsheets and does not have to do such reconstruction.

[7] *Fourth Report and Order*, ¶ 135.

There Is a Basis for Distinction

The FCC observes, "Furthermore, the record contains no convincing proposals that would allow us readily to identify any characteristics by which we could assign individual X-Factors to different price-cap carriers, so there could be multiple 'no sharing' X-Factors."[8] This statement seems to imply that the FCC, like a court of law, can consider only evidence that is submitted by the adversaries in the case. In reality, the FCC has already ranged far afield of the evidence submitted by the parties. Indeed, the whole new price-cap plan is based on productivity analysis conducted by the FCC Staff — analysis which differs substantially from any that has been submitted by the parties. It is a logical next step to use the same model to investigate the efficacy of different X-Factors for non-mandatory price-cap LECs.

There are several ways that the FCC might distinguish among LECs and have different X-Factors. The simplest possibility is to have one X-Factor for the mandatory price-cap LECs and a different X-Factor for other price-cap LECs. This possibility would be appropriate if the FCC Model indicated that non-mandatory companies are homogeneous but different from the mandatory companies. That outcome does not, however, seem likely. Two other possibilities are suggested by a study that we conducted in 1991 and filed at the FCC. According to that study:

- Companies that already have low unit costs tend to have slower productivity growth.[9] If the FCC model supports this finding, there should be a lower X-Factor for companies that already have low unit costs.
- LECs whose holding companies are smaller tend to have slower productivity growth. If the FCC model supports this finding, there should be a lower X-Factor for small holding companies.[10]

The FCC should test these (and other) possibilities with its own cost model. If differences in productivity growth are not related to any of these factors, the FCC would then have an evidentiary basis to support a single X-Factor. We believe that, on the contrary, such analysis would

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[8] *Ibid.*, ¶ 158.

[9] We denoted this finding as the Roseanne Barr effect. That is, it is easier for Roseanne Barr to lose weight than for Arnold Schwarzenegger.

[10] J. Rohlfs, "Differences in Productivity Gains Among Telephone Companies," prepared for CENTEL, September 3, 1991.

provide an evidentiary basis for different X-Factors for different companies.[11] Conceivably, there could be a different X-Factor for each company. However, rough justice (and administrative simplicity) could probably be achieved by having relatively few X-Factors for companies that fall into various categories.

Gaming of Multiple X-Factors

The FCC expresses concern that multiple X-Factors could be gamed by LECs.[12] This concern is certainly understandable. However, gaming would likely be a problem only if the multiple X-Factors are constructed so as to reward poor performance. There would be no problem of gaming if the multiple X-Factors were based on exogenous variables. Furthermore, X-Factors that are lower for low-cost companies encourage good performance. With lower X-factors, companies are allowed to capture a larger portion of the benefits yielded by gains in efficiency over the long run. They thereby enhance the efficiency incentives under price caps.

Choice of X-Factors

The FCC observes that virtually all the mandatory price-cap LECs have opted for the higher X-Factor during at least part of the interim price-cap period.[13] However, this finding obviously cannot justify a single X-Factor for *non-mandatory* price-cap LECs. In reality, the elections of non-mandatory price-cap LECs indicate considerably greater heterogeneity. For example, Southern New England Telephone Company elected the lower X-Factor for both years of the interim plan. Alltel has indicated its lower prospects for productivity growth by declining to elect price caps at all. Until this year, Cincinnati Bell did likewise. Furthermore, Cincinnati Bell and Aliant chose price-caps, in part, to enjoy the greater pricing flexibility that it needs to meet competition — not because it expects productivity growth in excess of 6.5 percent per year. A price-cap regime with multiple X-

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11 We hasten to add that we do not necessarily endorse the FCC's methods for estimating productivity. Nevertheless, the FCC should use a consistent analytical approach. Arbitrarily combining parts of one model (*e.g.*, the Staff Model) with parts of other inconsistent models (*e.g.*, the Norsworthy model, as corrected by Christensen) cannot lead to rational policies.

12 *Fourth Report and Order*, ¶ 159.

13 *Ibid.*, ¶ 157.

Factors would have the advantage of encouraging LECs with lower prospects for productivity growth to elect price caps. If the X-Factors are properly crafted, the outcome could be lower prices for consumers, as well as benefits to the firms.

In any event, one must be cautious in using elections of X-Factors to draw inferences about future productivity growth for the following reason:

> Price-caps are generally conceived as a win-win policy. That is, the productivity gains resulting from price caps are supposed to be shared by the company and its customers. The company's gains are manifest in earnings above its cost of capital. These earnings are expected to grow over the period of a price-cap plan. They decline, but not necessarily to zero, when a new price-cap plan begins.
>
> A company that has been under price-caps may elect a higher X-Factor to postpone sharing productivity gains that it made in the past. Such an election does not necessarily indicate that the company expects rapid productivity growth in the future.

Analysis of Cincinnati Bell and Aliant's Productivity

The FCC chose an overall X-Factor of 6.5 percent, of which 6.0 percent was to reflect productivity and 0.5 percent the CPD (consumer productivity dividend). The average of the 1991-1995 year-to-year X-Factor estimates calculated for the RBOCs was 5.2 percent. The FCC provides several reasons for selection of the 6.0 percent value from the range which varied from 3.4 percent to 6.8 percent. It referred to the RBOCs' consistent achievement of productivity growth near or at the upper end of the range of reasonableness (established at 6.3 percent). The FCC also notes the strong upward trend in productivity growth from 1992 to 1995.

In this section, we present estimates of Cincinnati Bell and Aliant's productivity growth to compare with that of the RBOCs. The estimates are based primarily on the productivity model developed by the FCC Staff. We did, however, need to make adjustments with respect to unregulated costs, measurement of local usage, and interstate special access. The consistent and upward-trending RBOC productivity growth holds using the slightly modified FCC's methodology that we used to perform the comparison. In contrast, however, the productivity growth for both Cincinnati Bell and Aliant over that period was neither consistent nor upward-trending.

Unregulated Costs

The productivity model developed by the FCC Staff does not include outputs associated with unregulated activities. Formally, this omission is manifest in the exclusion of Miscellaneous Revenues, which include revenues from unregulated activities.

As a matter of theory, a productivity model that excludes the outputs of unregulated activities should also exclude the inputs used to produce them. Otherwise, output growth and input growth are inconsistent and cannot be compared to estimate total factor productivity. The FCC Staff Model does not exclude the inputs used in unregulated activities. Failure to exclude such inputs is theoretically suspect. Nevertheless, that methodology may be reasonable for estimating RBOC productivity growth, since unregulated activities constitute only a small part of RBOC output.

That methodology is not, however, reasonable for Cincinnati Bell and Aliant. Unregulated activities are a larger fraction of Cincinnati Bell and Aliant's output than of RBOC output.[14] Furthermore, Cincinnati Bell and Aliant's unregulated activities have followed quite a different pattern than regulated activities; so regulated activities are not an adequate proxy for unregulated activities.[15]

For this reason, we exclude unregulated inputs from our analysis. Our estimates of unregulated inputs for Aliant and Cincinnati Bell are based on annual ARMIS reports.

Local Usage

Aliant data on the number of local calls exhibits a significant drop between 1990 and 1991. In that same period, the number of switched access minutes increased. In order to compensate for any possible data error or other anomaly in that period and to avoid overestimating productivity increases, we substituted a local dial equipment minutes (DEM) series for the local call data series. Local DEMs indicated a steady and consistent increase throughout the period.

We performed sensitivity analyses against our results to test effect of substituting local DEMs for local call data. Using local DEMs instead of local call data increased Cincinnati Bell's

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[14] An important reason for this difference is that Cincinnati Bell and Aliant are not subject to all the separate-subsidiary requirements that the RBOCs are subject to.

[15] In particular, unregulated activities have declined irregularly over the past several years, while regulated activities have grown fairly steadily.

price/productivity differential average for 1991-1995 by 0.5 percent per year. We also measured the effect of substituting local DEMs for call data in the RBOC calculation. Substitution of DEM for call data caused no change in the price/productivity differential average for 1991-1995. (Results for Cincinnati Bell and RBOCs using call data are provided in Tables 4 and 5, in the Appendix.)

These sensitivity analyses confirm the robustness of our estimates. They show that using different methodological approaches yields similar results, and that the gap with RBOC productivity is not merely the anomalous result of a particular measurement scheme. Also, because our use of DEMs increases the measured price/productivity differential average for Cincinnati Bell but does not affect that for the RBOCs, this adjustment serves to make our estimate of the productivity differential more conservative.

Special Access

Cincinnati Bell's data on the number of special-access lines have large year-to-year fluctuations. In any event, the data on number of special-access lines are probably not an adequate quantity index for output for special access. We therefore, exclude special-access from our analysis, as we did in our previous analysis.

The special-access line data for Aliant appeared to be consistent and thereby provide the opportunity to perform a sensitivity analysis on the impact on measured productivity caused by excluding special access for Cincinnati Bell. The analysis shows the impact is slight. The effect of excluding special access from Aliant is to decrease the price/productivity differential average for 1991-1995 by only 0.3 percent per year. The effect of excluding special access from the RBOC calculation is to decrease the price/productivity differential average for 1991-1995 by 0.9 percent per year. (Results for Aliant and RBOCs including special access in the calculation are provided in Tables 5 and 6, in the Appendix).

These sensitivity analyses also confirm the robustness of our estimates. As before, they show that using different methodological approaches yields similar results, and that the gap with RBOC productivity is not merely the anomalous result of a particular measurement scheme. Also, as the decrease in measured RBOC productivity is greater than that for Aliant, this adjustment serves to make our estimate of the difference more conservative.

Results

In our analysis, we are not especially concerned with the absolute levels of productivity growth. Rather, we examine the *difference* in productivity growth between RBOCs, Cincinnati Bell, and Aliant. To ensure comparability, we treat all three entities the same; *i.e.*, we exclude special access and use local DEM instead of local call data.

Table 1 shows results of applying the FCC's methodology, modified as described above, to Cincinnati Bell data. The table shows that Cincinnati Bell's average price/productivity differential from 1990 to 1995 was 3.1 percent per year. The average from 1991 to 1995 was 3.3 percent per year. Table 2 shows results of applying FCC's methodology, modified as described above, to Aliant data. The table shows that Aliant's average price/productivity differential from 1990 to 1995 was 2.6 percent per year. The average from 1991 to 1995 was 2.7 percent per year.

The RBOC results, adjusted for special access and substituting DEMs for local calls, are shown in Table 3. The RBOC price/productivity differential, excluding special access, averaged 4.6 percent per year from 1990 to 1995 and 4.3 percent from 1991 to 1995.

The difference between the Cincinnati Bell and Aliant and RBOC results is enormous. The Cincinnati Bell difference amounted to 1.5 percent per year from 1990 to 1995 and 1.0 percent per year from 1991 to 1995. The Aliant difference amounted to 2.0 percent per year from 1990 to 1995 and 1.6 percent per year from 1991 to 1995. The differentials were even greater in 1994 and 1995, when Cincinnati Bell was subject to incentive regulation and Aliant was subject to price caps. The differential for Cincinnati Bell averaged 4.8 percent per year for those years, while the differential for Aliant was only slightly higher than for 1991-1993. These data strongly suggest that Cincinnati Bell and Aliant both have lower prospects for productivity growth than do RBOCs. This finding is consistent with past studies, which also demonstrated that Cincinnati Bell's productivity growth is slower than that of larger LECs.[16]

Efficiency of Cincinnati Bell and Aliant

The lower productivity growth does not indicate that Cincinnati Bell nor Aliant are less efficient than the RBOCs. On the contrary, Cincinnati Bell is a low-cost company. Cincinnati

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[16] *See* J. Rohlfs, "Incentive Regulation and Estimates of Productivity," prepared for Cincinnati Bell Telephone Company (Attachment I), June 9, 1989. *See* also Rohlfs (1991).

Bell's price for interstate switched access was only $0.021 per minute in 1995. This can be compared to the average RBOC price of $0.028 per minute. The Cincinnati Bell price was almost 40 percent lower than the RBOC price. These price differences reflect differences in unit costs allocated to the interstate jurisdiction. As discussed above, further productivity gains are more difficult for companies that already have low cost.

Aliant's price for interstate switched access was slightly higher than the RBOCs' in 1995. Aliant is a small holding company, and previous research has shown that small holding companies exhibit lower productivity growth.[17] Also, unlike some RBOCs, Aliant serves a large rural population — 40 percent of Aliant's access lines are outside the a metropolitan Lincoln/Lancaster area.

Conclusions

Our productivity analysis demonstrates that Cincinnati Bell and Aliant have had slower productivity growth than the RBOCs. The slow growth does not indicate poor performance by either company. On the contrary, Cincinnati Bell has lower unit costs than the RBOCs and Aliant has comparable unit costs, even though it is much smaller and serves a significant rural population. It is difficult for Cincinnati Bell, Aliant, or any other firm to realize productivity gains at the same rate that higher-cost firms can improve their productivity.

More importantly, one size of price-cap plan does not fit all LECs. It is unfair and inequitable for the FCC to use the same X-Factor for firms that have substantially different prospects for productivity growth. Multiple X-Factors can be developed and used without significant administrative burdens and without allowing gaming by LECs.

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[17] *See* Rohlfs (1991).

Table 1:

Cincinnati Bell Estimates based on FCC Staff Model
(Using DEMs, excluding Special Access)

Components of FCC LEC Price Cap X-Factor [Excluding CPD]

	Input Price Growth Rates			Total Factor Productivity Growth Rates			CBT
	CBT	U.S. Nonfarm Business Sector	Differential	CBT	U.S. Nonfarm Business Sector	Differential	Price/Productivity Differential
Year	A	B	C = B - A	D	E	F = D - E	G = C + F
1990	-0.03%	3.31%	3.34%	-1.64%	-0.47%	-1.17%	2.2%
1991	2.11%	2.06%	-0.05%	-0.16%	-0.89%	0.73%	0.7%
1992	-5.09%	2.88%	7.97%	-0.90%	1.10%	-2.01%	6.0%
1993	-1.37%	3.72%	5.08%	3.20%	0.55%	2.65%	7.7%
1994	6.49%	3.50%	-2.99%	3.80%	0.50%	3.30%	0.3%
1995*	-1.30%	3.09%	4.39%	-2.37%	0.16%	-2.53%	1.9%
Averages							
[1990-95]	0.14%	3.09%	2.96%	0.32%	0.16%	0.16%	3.1%
[1991-95]	0.17%	3.05%	2.88%	0.71%	0.28%	0.43%	3.3%

*Columns B and E for 1995 are estimated, based on the average of 1990-1994.

Table 2:

Aliant Estimates based on FCC Staff Model
(Using DEMs, excluding Special Access)

Components of FCC LEC Price Cap X-Factor [Excluding CPD]

	Input Price Growth Rates			Total Factor Productivity Growth Rates			Aliant
	Aliant	U.S. Nonfarm Business Sector	Differential	Aliant	U.S. Nonfarm Business Sector	Differential	Price/Productivity Differential
Year	A	B	C = B - A	D	E	F = D - E	G = C + F
1990	1.73%	3.31%	1.58%	-0.05%	-0.47%	0.43%	2.0%
1991	3.36%	2.06%	-1.31%	-2.52%	-0.89%	-1.63%	-2.9%
1992	1.07%	2.88%	1.81%	2.84%	1.10%	1.73%	3.5%
1993	-0.36%	3.72%	4.08%	1.05%	0.55%	0.50%	4.6%
1994	4.31%	3.50%	-0.81%	4.42%	0.50%	3.92%	3.1%
1995*	4.09%	3.09%	-1.00%	6.45%	0.16%	6.29%	5.3%
Averages							
[1990-95]	2.37%	3.09%	0.73%	2.03%	0.16%	1.87%	2.6%
[1991-95]	2.50%	3.05%	0.55%	2.45%	0.28%	2.16%	2.7%

*Columns B and E for 1995 are estimated, based on the average of 1990-1994.

Table 3:

RBOC Estimates based on FCC Staff Estimates
(Using DEMs, Excluding Special Access)

Components of FCC LEC Price Cap X-Factor [Excluding CPD]

	Input Price Growth Rates			Total Factor Productivity Growth Rates			LEC
	Total RBOCs	U.S. Nonfarm Business Sector	Differential	Total RBOCs	U.S. Nonfarm Business Sector	Differential	Price/Productivity Differential
Year	A	B	C = B - A	D	E	F = D - E	G = C + F
1990	1.88%	3.31%	1.43%	4.43%	-0.47%	4.90%	6.3%
1991	-0.85%	2.06%	2.91%	-0.92%	-0.89%	-0.03%	2.9%
1992	2.68%	2.88%	0.21%	3.66%	1.10%	2.56%	2.8%
1993	2.27%	3.72%	1.44%	3.24%	0.55%	2.69%	4.1%
1994	-0.19%	3.50%	3.69%	1.69%	0.50%	1.18%	4.9%
1995*	1.31%	3.09%	1.78%	5.16%	0.16%	5.00%	6.8%
Averages							
[1990-95]	1.18%	3.09%	1.91%	2.88%	0.16%	2.72%	4.6%
[1991-95]	1.04%	3.05%	2.01%	2.56%	0.28%	2.28%	4.3%

*Columns B and E for 1995 are estimated, based on the average of 1990-1994.

APPENDIX:

Sensitivity Analyses (Tables 4-7)

Table 4:

Cincinnati Bell Estimates based on FCC Staff Model
(Using Local Calls, excluding Special Access)

Components of FCC LEC Price Cap X-Factor [Excluding CPD]

	Input Price Growth Rates			Total Factor Productivity Growth Rates			CBT
	CBT	U.S. Nonfarm Business Sector	Differential	CBT	U.S. Nonfarm Business Sector	Differential	Price/Productivity Differential
Year	A	B	C = B - A	D	E	F = D - E	G = C + F
1990	-0.03%	3.31%	3.34%	-6.60%	-0.47%	-6.13%	-2.8%
1991	2.11%	2.06%	-0.05%	-0.66%	-0.89%	0.23%	0.2%
1992	-5.09%	2.88%	7.97%	-1.82%	1.10%	-2.92%	5.1%
1993	-1.37%	3.72%	5.08%	3.41%	0.55%	2.86%	7.9%
1994	6.49%	3.50%	-2.99%	5.02%	0.50%	4.52%	1.5%
1995*	-1.30%	3.09%	4.39%	-5.19%	0.16%	-5.35%	-1.0%
Averages							
[1990-95]	0.14%	3.09%	2.96%	-0.97%	0.16%	-1.13%	1.8%
[1991-95]	0.17%	3.05%	2.88%	0.15%	0.28%	-0.13%	2.8%

*Columns B and E for 1995 are estimated, based on the average of 1990-1994.

Table 5:

RBOC Estimates based on FCC Staff Estimates
(Using Local Calls, excluding Special Access)

Components of FCC LEC Price Cap X-Factor [Excluding CPD]

	Input Price Growth Rates			Total Factor Productivity Growth Rates			LEC
Year	Total RBOCs A	U.S. Nonfarm Business Sector B	Differential C = B - A	Total RBOCs D	U.S. Nonfarm Business Sector E	Differential F = D - E	Price/Productivity Differential G = C + F
1990	1.88%	3.31%	1.43%	5.69%	-0.47%	6.16%	7.6%
1991	-0.85%	2.06%	2.91%	0.78%	-0.89%	1.67%	4.6%
1992	2.68%	2.88%	0.21%	3.89%	1.10%	2.79%	3.0%
1993	2.27%	3.72%	1.44%	2.14%	0.55%	1.59%	3.0%
1994	-0.19%	3.50%	3.69%	1.34%	0.50%	0.84%	4.5%
1995*	1.31%	3.09%	1.78%	4.85%	0.16%	4.69%	6.5%
Averages							
[1990-95]	1.18%	3.09%	1.91%	3.12%	0.16%	2.96%	4.9%
[1991-95]	1.04%	3.05%	2.01%	2.60%	0.28%	2.32%	4.3%

*Columns B and E for 1995 are estimated, based on the average of 1990-1994.

Table 7:

RBOC Estimates based on FCC Staff Estimates
(Using DEMs, including Special Access)

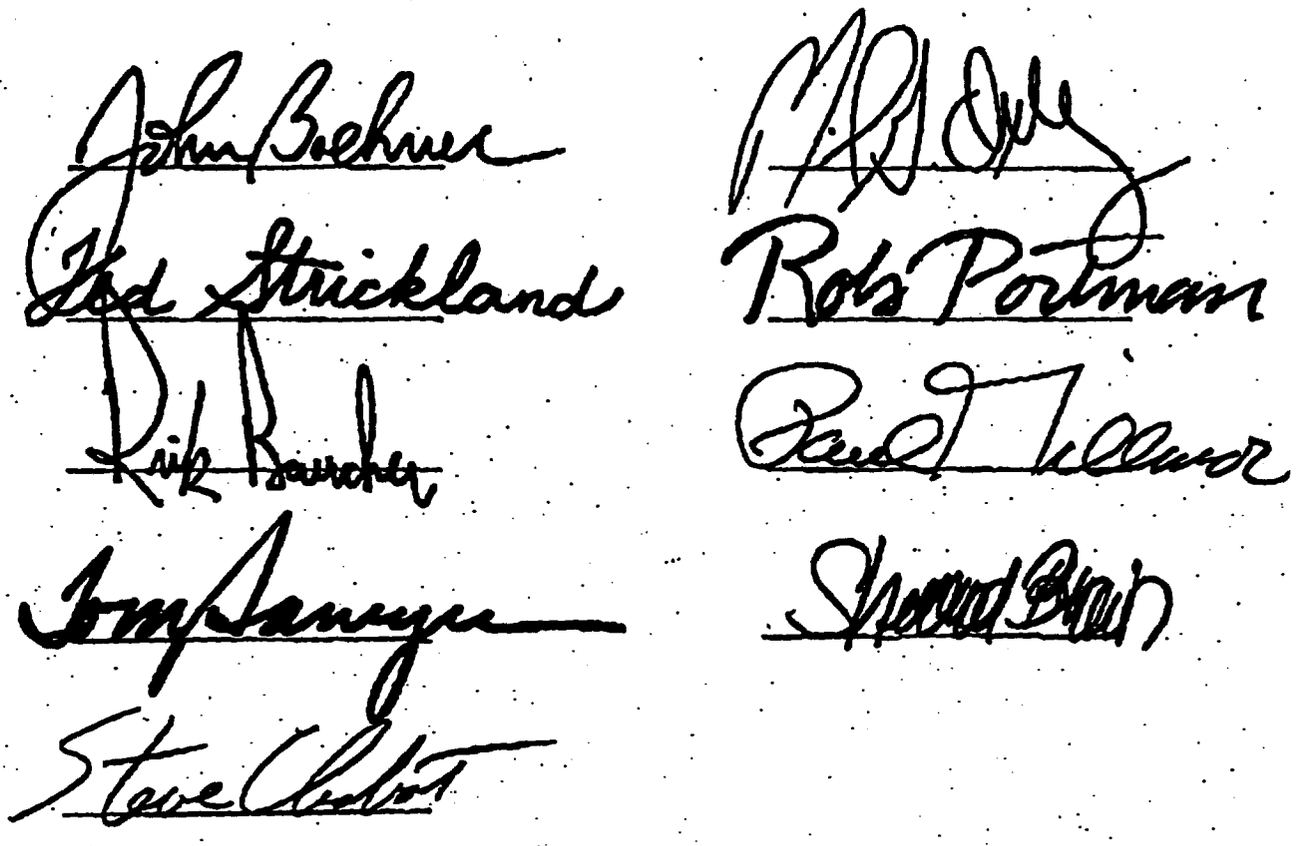
Components of FCC LEC Price Cap X-Factor [Excluding CPD]

	Input Price Growth Rates			Total Factor Productivity Growth Rates			LEC
Year	Total RBOCs A	U.S. Nonfarm Business Sector B	Differential C = B - A	Total RBOCs D	U.S. Nonfarm Business Sector E	Differential F = D - E	Price/Productivity Differential G = C + F
1986	4.94%	2.81%	-2.13%	#N/A	0.92%	#N/A	#N/A
1987	0.56%	2.53%	1.97%	#N/A	-0.02%	#N/A	#N/A
1988	-1.58%	3.73%	5.31%	#N/A	0.46%	#N/A	#N/A
1989	-2.36%	3.04%	5.40%	1.10%	-0.55%	1.66%	7.1%
1990	1.88%	3.31%	1.43%	5.63%	-0.47%	6.11%	7.5%
1991	-0.85%	2.06%	2.91%	0.39%	-0.89%	1.28%	4.2%
1992	2.68%	2.88%	0.21%	4.10%	1.10%	2.99%	3.2%
1993	2.27%	3.72%	1.44%	4.87%	0.55%	4.32%	5.8%
1994	-0.19%	3.50%	3.69%	2.55%	0.50%	2.04%	5.7%
1995*	1.31%	3.09%	1.78%	5.49%	0.16%	5.33%	7.1%
Averages							
[1990-95]	1.18%	3.09%	1.91%	3.84%	0.16%	3.68%	5.6%
[1991-95]	1.04%	3.05%	2.01%	3.48%	0.28%	3.19%	5.2%

*Columns B and E for 1995 are estimated, based on the average of 1990-1994.

applicable Commission rules and regulations, and look forward to working with you to advance competitive telecommunications policies.

Sincerely,



Signed by:

John Boehner
Ted Strickland
Rick Boucher
Tom Sawyer
Steve Chalbot
Michael G. Oxley
Rob Portman
Paul Gillmor
Sherrod Brown

ATTACHMENT D

INCENTIVE REGULATION AND ESTIMATES OF PRODUCTIVITY

A Study Prepared for Cincinnati Bell Telephone Company

by

National Economic Research Associates, Inc. (NERA)
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June 9, 1989

n/e/r/a

INCENTIVE REGULATION AND ESTIMATES OF PRODUCTIVITY

A Study Prepared for Cincinnati Bell Telephone Company

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National Economic Research Associates, Inc. (NERA)

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I. INTRODUCTION

On March 16, 1989, the Federal Communications Commission (FCC) adopted a price-cap plan which will replace traditional rate-of-return regulation for AT&T. At the same time, the Commission issued a Second Further Notice of Proposed Rulemaking (FFNPRM).[1] Therein, the FCC proposes, but does not adopt, implementation of incentive regulation for local exchange carriers (LECs).

In many respects, the plan proposed for the LECs resembles that passed for AT&T. It would allow prices to increase annually to account for the following factors: the increase in the GNP price deflator, the productivity factor, a consumer "dividend", and other exogenous (beyond control of the carriers) cost changes. The proposed LEC productivity factor (2.5%) and consumer dividend (0.5%) are the same as were implemented in the AT&T plan.

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[1] Federal Communications Commission, Report and Order and Second Further Notice of Proposed Rulemaking, CC Docket No. 87-313, In the Matter of Policy and Rules Concerning Rates for Dominant Carriers (March 16, 1989).

This paper addresses two points concerning the FCC's proposed plan of incentive regulation. We first demonstrate that Cincinnati Bell should not be held to the same productivity factor as the regional Bell operating companies (RBOCs). We present three separate analyses which quantify and explain the differential between Cincinnati Bell and RBOC productivity measures.

The subsequent section of the paper argues that incentive regulation should be a voluntary, rather than mandatory, option for the LECs. Given the lack of persuasive evidence that a 2.5% productivity factor will allow for a fair rate of return, it is premature to adopt incentive regulation as a mandatory measure -- even with the automatic stabilizer. The Commission should definitely move ahead so that the public can reap the benefits of incentive regulation. However, enforcing such regulation on a diverse group of companies as if they all faced the same circumstances when, in fact, they do not can be unfairly detrimental to some companies, including Cincinnati Bell.

II. THE PRODUCTIVITY FACTOR FOR CINCINNATI BELL SHOULD BE LOWER THAN FOR THE RBOCs

A. Introduction

It is unfair to impose the same productivity factor on Cincinnati Bell as on the RBOCs. Several separate analyses prove that the productivity gains of Cincinnati Bell have been substantially lower than those of the RBOCs. Although Cincinnati Bell is an efficient company, its productivity gains have not reached the proportions of the RBOCs. This fact cannot be ignored when arriving at the fair productivity factor to apply to Cincinnati Bell in the future.

B. Cincinnati Bell Study of Pre-divestiture Productivity

Prior to the AT&T divestiture, Cincinnati Bell completed a study of its total factor productivity between 1972 and 1980. The study is attached as Appendix A to this paper. The methodology used in the productivity study closely resembles the gross value-added (two-factor) method used in the "Bell System Productivity Study: 1947-1979."[2]

Since the two studies use such similar methodologies, the estimates provide a good comparison of the productivity gains of the Bell System and those of Cincinnati Bell. According to these estimates, Bell System productivity improved 1.3% per year more rapidly than Cincinnati Bell's between 1972 and 1979.[3]

The Commission has stated that it believes that the total output (three-factor) method provides better estimates of productivity than does the gross value-added method.[4] We therefore used the total output method to recalculate Cincinnati Bell's productivity estimates. This analysis is presented in Appendix B. The resulting productivity estimates can be compared to the Bell System estimates obtained using the total output method.

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[2] American Telephone and Telegraph Company, "Bell System Productivity Study: 1947-1979," Economic Analysis Division (September 1980).

[3] Cincinnati Bell's increases in productivity are shown on p. 6 of Appendix A. The company's productivity increased 28% from 1972 to 1979. This corresponds to a compound growth rate of 3.6% per year. During the same period, Bell System productivity increased at a compound rate of 4.9% per year.

[4] Federal Communications Commission, Further Notice of Proposed Rulemaking, CC Docket 87-313, In the Matter of Policy and Rules Concerning Rates for Dominant Carriers, 3 FCC Rcd 3195 (1988). (Hereinafter, FNPRM.)

According to that comparison, Bell System productivity grew 1.1% more rapidly than Cincinnati Bell's between 1972 and 1979.[5]

C. Use of Cincinnati Bell Price Data to Infer Productivity

The Commission bases its analysis of productivity largely on studies of total factor productivity. One can also infer productivity from price data, because productivity gains must be passed on either to customers in the form of lower prices or to investors in the form of higher returns. If we adjust price data for changes in returns to investors, we are left with a valid measure of productivity.

Returns to local exchange and long distance operations have similar patterns with regard to returns to investors. Returns in both sectors follow overall trends in interest rates with a lag. Consequently, price data provide a rough measure of productivity differences between local and long-distance operations, without any adjustment for changes in returns to investors.

By definition, the rate of change in output prices for a firm or an industry is equal to the change in its input prices (including exogenous changes in costs) less the change in its total factor productivity:

$$(1) \qquad TO = [TI + TZ] - TTFP$$

[5] Cincinnati Bell's increase in productivity according to the three-factor method was 3.1% per year from 1972 to 1979 (see Table 1 of Appendix B). During the same period, Bell System productivity improvement according to the three-factor method was 4.2% per year.

where TO represents the annual percentage change in the telecommunications industry (or firm) output prices, TI represents the annual percentage change in its input prices, TTFP represents the annual percentage change in its total factor productivity (the ratio of an index of physical quantities of outputs to an index of physical quantities of inputs), and TZ represents changes in costs due to external circumstances (e.g., tax rate changes) expressed as a percentage of total cost. The only assumption necessary to derive this relationship is that the change in industry profits is zero over time. Assuming further that there are no changes in excess profits in the economy as a whole, equation (1) can be derived for the nation as a whole in the same manner as it was derived above:

$$(2) \qquad NO = [NI + NZ] - NTFP$$

where NO is the annual change in a national index of output prices, NI is the annual change in a national index of input prices, NTFP is the annual change in the economy-wide total factor productivity, and NZ represents exogenous cost changes expressed as a fraction of total cost. Assuming NI = TI, substituting equation (2) into equation (1) and replacing NI by TI, we see that

$$(3) \qquad TO = NO - [TTFP-NTFP] + [TZ-NZ]$$

In words, the change in the average output price for an industry or a firm is equal to (i) the change in a national index of output prices less (ii) the difference between the change in total factor productivity for the industry or firm and for the nation as a whole, plus (iii)

the difference between the effect of exogenous cost changes in the industry or firm and the nation as a whole. The change in productivity (relative to the national average) can be estimated by adjusting the firm's output prices for exogenous changes, calculating the rate of growth of the adjusted prices, and subtracting the result from the growth rate of the GNP price deflator.

We performed an analysis of Cincinnati Bell's prices during the post-divestiture period. It is attached as Appendix C to this paper. The methodology closely resembles that used in studies done by Bellcore and filed with the Commission.[6] In the study, 1984 revenue requirements per unit of output are calculated for common line, traffic sensitive, and special access services, along with the appropriate demand volumes. The 1988 revenue requirements were adjusted for service category-specific Z adjustments, and net revenue requirements per unit of output were calculated. The negative of the difference between the rate of growth of the price index relative to 1984 and the rate of growth of the GNP-PI deflator over the period yields the average productivity factor for access services. Since the methodologies of the Cincinnati Bell and Bellcore studies are so similar, they provide a good comparison of the RBOC's productivity gains and Cincinnati Bells's.

According to our analysis, the productivity ("X") factor for Cincinnati Bell from 1984 to 1988 was 0.3% per year.[7] Using the same methodology, Bellcore estimated a

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[6] Bellcore, "The Impact of Federal Price Cap Regulation on Interstate Toll Customers," (March 17, 1988) and "The Impact of the FCC Proposed Price Cap Plan on Interstate Consumers," (August 18, 1988).

[7] This estimate does not take account of the unique treatment of common line productivity growth proposed by the Commission in the FFNPRM. That adjustment would make the productivity factor substantially negative, as shown in Appendix C, Table 3.2 and the following discussion. The Appendix C calculation does not take into account the Commission's Clarification of May 30, 1989.

relative productivity factor of 3.33% per year for the RBOCs. Thus, from 1984 to 1988, the productivity of Cincinnati Bell was roughly three full percentage points per year less than that of the RBOCs.

D. Cincinnati Bell Study of Post-Divestiture Productivity

In 1987, Cincinnati Bell performed a study of Cincinnati Bell's productivity in the post-divestiture period.[8] We reviewed that study and made several improvements in methodology. The improvements are discussed in Appendix D. As a result, we were able to derive our own estimates of Cincinnati Bell's total factor productivity in the post-divestiture period. According to our estimates, Cincinnati Bell's total factor productivity in the post-divestiture period is within half a percent per year of both the Bureau of Labor Statistics and American Productivity Center's measures of economy-wide productivity.[9] The gains were much less than 2.5% per year above economy-wide productivity.

E. Cincinnati Bell's Record of Efficiency

Although Cincinnati Bell's productivity has grown more slowly than that of the RBOCs in recent years, the company nevertheless maintains a high level of efficiency. For example, its net investment per line is 19% below the Bell average and 28% below the

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[8] Cincinnati Bell Telephone Company, "Total Factor Productivity Research Project #Q502," 1988.

[9] Cincinnati Bell's productivity gain was 1.9% per year (see Appendix D). The economy-wide gain from 1984 to 1987 was 1.5% per year according to the U.S. Bureau of Labor Statistics and 2.3% per year according to the American Productivity Center.

average of the other independents.[10] According to this measure, Cincinnati Bell is more efficient than the average of either the Bell or independent telephone companies. In 1987, Cincinnati Bell had 174 access lines per employee. This compares to 200 access lines per employee for all Bell companies and 162 for other independents. By this measure, Cincinnati Bell is less efficient than the Bell average but more efficient than other independents.

While some of Cincinnati Bell's efficiencies may be attributed to the shorter loops needed in the urban area served by Cincinnati Bell, the data indicate an efficient operation. In other words, Cincinnati Bell enjoys a high level of efficiency, but has not experienced the changes in efficiency that AT&T and the RBOCs did. Since Cincinnati Bell already operates efficiently, further improvements are naturally more difficult.

F. Summary

We have used three different approaches to examine Cincinnati Bell's productivity. All three approaches indicate that Cincinnati Bell's productivity has grown much less rapidly than that of the RBOCs.[11] The productivity factor for Cincinnati Bell should

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[10] Net investment and number of lines data from the United States Telephone Association's 1988 Telephone Statistics. Although approximately half of the independents did not report, they accounted for a relatively small portion of the total independents' output. Calculated 1987 investment per line for Cincinnati Bell was $993; for the other independents, $1,382; and the Bell average was $1,233. USTA considers Cincinnati Bell and Southern New England Telephone, as well as the RBOCs, to be Bell companies.

[11] Our pre-divestiture analysis compares Cincinnati Bell's productivity to that of the Bell System. Although the Commission assumes Bell System productivity equals BOC productivity, that assumption may be suspect, as discussed below. See p. 13 ff.

therefore be substantially lower than for the RBOCs. Our quantitative results suggest that the differential should exceed one full percentage point per year.

III. PRICE CAPS SHOULD BE VOLUNTARY

A. Introduction

The Commission's regulatory plan for AT&T differs from that proposed for LECs in that the latter includes an automatic stabilizer that will trigger a rate reduction when the LEC's rate of return exceeds a specified level (such as 2% above the currently-allowed rate of return) or a rate increase when the rate of return falls below a certain level (such as 2% below the currently-allowed rate of return).[12] The FCC found that such additional safeguard mechanisms were not needed for AT&T because, ". . .the record evidence of its productivity does not reflect the same uncertainty as it does with regard to the LECs."[13] The uncertainty regarding LEC productivity derives from diversity among the LECs, as well as conflicting productivity estimates that have been derived over the years.

Price cap regulation will be mandatory for AT&T, though AT&T would almost certainly have opted for price cap regulation if it were voluntary. The Commission proposes that incentive regulation also be mandatory for depooled "Tier 1" LECs (i.e., those having more than $100 million in total company regulated revenues[14]), which include

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[12] The Commission also suggests an alternative safeguard for keeping the LECs within a zone of reasonableness; namely more frequent reviews of the plan.

[13] FFNPRM, p. 27, par. 55.

[14] Tier 1 carriers are currently defined as those companies having more than $100 million in total company regulated revenues, as determined by the 1984 Annual Statistical Volume II of the USTA Statistical Reports Class A and B Telephone Companies for the Year 1983. Beginning in 1990, however, each company's benchmark of $100 million in regulated revenues will be reevaluated annually based upon the company's performance over the previous five years, rather than being fixed based upon its 1983 performance. (FFNPRM at fn. 1308.)

Cincinnati Bell Telephone Company. It is not at all obvious that all Tier 1 LECs would (if given a choice) opt for incentive regulation in whatever form is finally adopted by the Commission. The policy of mandatory incentive regulation differs sharply from the voluntary plans proposed by the Commission in previous notices. In this section, we argue that voluntary incentive regulation is a far better approach. Mandatory incentive regulation is especially inappropriate, given the uncertainty about LEC productivity. To be sure, the automatic stabilizer ameliorates the problems associated with uncertain data, but it falls far short of solving those problems entirely.

B. Voluntary Incentive Regulation

Voluntary incentive regulation involves a voluntary agreement between the Commission and the carriers. Carriers that volunteer for such a plan agree to accept the poor level of profits that may result if productivity and/or demand grow less rapidly than expected. In exchange, such carriers have the prospect of higher profits if their performance is exceptionally good or if conditions turn out to be favorable. At the same time, all carriers have the opportunity to earn a fair return on capital, in the sense that if they find the Commission's proposed productivity factor to be too ambitious, they can simply elect to continue with rate-of-return regulation.

Under voluntary incentive regulation, the Commission's proposed procedures for above-cap filings are entirely appropriate. The Commission proposes to demand extremely high standards of proof for such filings. In particular, it states that several thousand pages of documentation may underestimate the scope of documentation that would be required. It states that above-cap filings would almost surely be subject to the maximal five months'

suspension. In general, the Commission proposes to use its full administrative discretion to delay and minimize above-cap rate increases.[15] Although severe, this approach is reasonable if the carriers have voluntarily agreed to incentive regulation. The FCC would simply be holding the carriers to their part of the deal.

Under voluntary incentive regulation, uncertainty regarding productivity need not be a serious problem. The Commission could reason that the public will benefit even if the Commission guesses a bit low on the productivity factor. Carriers may get small windfall profits for a few years (though limited by the automatic stabilizer), but then the plan can be revised. Thereafter, consumers will get the full benefits of productivity gains, in addition to the consumer dividend. The economy will also benefit, generally, because incentive regulation would improve the carriers' incentives to make needed investments in the public telecommunications infrastructure, thereby making the United States more competitive in the global information-services marketplace.

If the Commission sets the productivity factor unrealistically, few if any companies will volunteer for price caps. That would certainly be unfortunate, and would forfeit much of the substantial public benefit that incentive regulation can potentially provide. Nevertheless, the policy would cause the industry's performance to improve moderately, as opposed to continuing with rate-of-return regulation.

Voluntary price caps can also accommodate differences among carriers. If a carrier has few opportunities for productivity improvement, it can elect to remain under rate-of-

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[15] These issues are discussed in the FFNPRM on pp. 237-39 with regard to AT&T. On p. 386, the Commission proposes the same filing requirements and cost showings for LECs, though it also seeks comments on whether the burden of proof for small telephone companies should be different.

return regulation and thereby not be denied the opportunity to earn a fair return to capital. At the same time, the public can benefit as other carriers elect incentive regulation.

The Commission is concerned about "adverse selection" under voluntary incentive regulation. That is, one would obviously expect that the most productive LECs will elect voluntary incentive regulation, while the least productive ones will not. Hence, the productivity of the group that chooses incentive regulation will exceed the average productivity of all LECs.

Adverse selection is certainly an issue, but (as discussed herein) mandatory incentive regulation is not a good way to deal with it. Taking account of adverse selection by setting a higher productivity factor is far better policy. The differential would be quite modest if all the RBOCs opted for incentive regulation. In any event, our analysis below suggests that a productivity factor of 2.5% per year is probably excessive for LECs -- even taking adverse selection into account.

C. Mandatory Incentive Regulation

The Commission's proposed procedures for above-cap filings are highly inappropriate under mandatory incentive regulation. Because such regulation is not voluntary, the Commission can no longer reason that a deal is a deal. It must therefore have some other justification for using its full administrative discretion to delay and minimize rate increases for carriers that are earning less than their cost of capital.

The only possible justification would be that the Commission has previously determined that its productivity factor gives the carrier the opportunity to earn a fair return on capital. In doing so, the Commission must accept the burden of proof. If it does not

meet this burden of proof (and we demonstrate below that it clearly has not), the carrier should be able to apply for above-cap increases without being subjected to unreasonably severe evidentiary requirements. Indeed, such requirements would constitute confiscation of property.

The Commission may reason that incentive regulation is simply not workable without severe evidentiary requirements for above-cap rate increases. If so, the appropriate solution is voluntary price caps.

The automatic stabilizer ameliorates these problems but falls far short of eliminating them entirely.[16] In particular, a carrier's return must fall substantially (two hundred basis points according the Commission's proposal) below its cost of capital before the automatic stabilizer is triggered. Furthermore, the carrier may be entitled to recover only part (half in the Commission's proposal) of losses beyond the trigger point. A carrier's potential losses under an automatic stabilizer could therefore be very large. They cannot be ignored simply because the losses would be still greater without the automatic stabilizer.

D. Pre-Divestiture Productivity Analysis

(1) Introduction

The FCC examined pre-divestiture telecommunications price data in assessing the appropriate LEC productivity factors. The information on productivity analyzed, covering the period prior to 1984, included long distance services as well as local services. Regarding the pre-divestiture data, the FCC conceded that ". . .much of the long term

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[16] The automatic stabilizer also reduces the incentives of carriers to improve their performance; that issue is beyond the scope of this paper.

productivity data in the record concern unified, pre-divestiture Bell System operations. In other words, these data do not distinguish interstate interexchange operations from interstate local exchange services. This raises the issue of whether such data can serve as a basis for predicting the potential future productivity gains of the divested components of that system."[17] The Commission concludes, ". . .there is not persuasive evidence that the productivity effects of technological advancement are being realized to a greater degree by the LECs relative to AT&T, or vice versa. Therefore, we tentatively conclude here, as we did in the Further Notice, that arguments of this nature, unsupported by empirical evidence, provide no basis for selecting a productivity number that differs from the long term historical number of 2.5% relative to the economy as a whole."[18]

The FCC's assumption of equal productivity gains for local exchange and long distance operations is completely arbitrary. One could equally-well assume, given no evidence one way or the other, that the productivity of the long-distance sector grew (say) 5% per year more rapidly than that of the local exchange sector. The FCC has not even proved that prior to divestiture the productivity of the local exchange sector grew more rapidly than that of the economy as a whole -- let alone 2.5% per year more rapidly.

The Commission's procedure is wholly inadequate for setting productivity factors for mandatory incentive regulation. It is guess-work, not evidence. Furthermore, as discussed below, there are many reasons for supposing that prior to divestiture the productivity of the long-distance sector grew substantially more rapidly than that of the local exchange sector.

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[17] FFNPRM, p. 337, par. 694.

[18] FFNPRM, p. 338, par. 697.

(2) Technological Developments

Before considering the quantitative evidence on productivity, we examine the technological developments that led to productivity improvements. This analysis provides useful background for interpreting the quantitative results.

Technology advanced extremely rapidly in the long distance sector in the four decades prior to divestiture. Virtually every aspect of the long-distance business was subjected to major cost reductions. Major developments included the following:

1. Automatic message accounting
2. Outward direct distance dialing
3. Operator mechanization
4. Microwave transmission
5. Electronic switching (analog and digital)
6. Carrier systems (analog and digital)

The local exchange, as well as the long-distance, sector benefited from electronic switching. The local exchange sector also benefited from the use of carrier systems for interoffice transmission. In addition, local exchange operations enjoyed cost savings from mechanization of directory assistance and automatic intercept.

Nevertheless, one aspect of local exchange operations enjoyed little technological progress prior to divestiture; namely, the local loop. The technology used in 1983 closely resembles that used in 1943 and earlier. Protective sheathing for cables has been improved, but a substantial amount of expensive construction labor is still required to install cables, whether buried, aerial, or underground. For this reason, it is reasonable to

suspect that productivity in the long-distance sector outpaced that in the local exchange sector. As we shall see, the available quantitative evidence supports this view.

We must also distinguish between productivity gains in various parts of the interstate jurisdiction. In particular, we must distinguish between access and interexchange operations. In this regard, we note that interexchange is almost entirely a high-tech operation. It consists primarily of switching and interoffice transmission. On the other hand, almost half of the revenue requirement for interstate access derives from the interstate allocations of local loops.

(3) Average Revenue Data

Separate price indices are not available for local exchange and long distance services prior to 1977. Nevertheless, data on average revenues are available and shed some light on productivity differences.

Between 1950 and 1981, average local revenues per access line rose 4.7% per year. (CPI + 0.3%).[19] During the same period, average revenues per interstate message rose 2.85% per year (CPI -1.5%).[20] Thus, average revenues for local services rose 1.85% per year more rapidly than average revenues for interstate services. Furthermore, during this whole period, the division of revenues process allocated an increasing fraction of costs to the interstate jurisdiction. If the interstate allocations remained the same, local rates would

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[19] We compare rate increases to the CPI because data on GNP-PI are available only from 1959.

[20] These data are from the Bell System Statistical Manual. AT&T provided these data to the Federal Communications Commission.

have increased more rapidly; interstate rates would have increased less rapidly and may even have declined.

These average revenues are far from perfect price indices. Even so, the difference between the growth rates for local and long-distance is so large that it is noteworthy.

(4) Price Indices

Starting in 1977, the Bureau of Labor Statistics developed separate price indices for local, intrastate long-distance, and interstate long-distance prices. From 1977 to 1983, the local price index rose 2.64% per year more rapidly than the interstate price index.[21]

During this period, the division of revenues was controlled by the Ozark formula, which rapidly increased the fraction of costs allocated to the interstate jurisdiction. If the fraction remained the same, local rates would have risen even more rapidly; interstate rates would have declined less rapidly and perhaps even fallen.

(5) Christensen Productivity Study

Additional insight into the relative rate of growth of TFP for local and long distance service is provided by a 1981 study performed by Professor Laurits R. Christensen.[22] Christensen's comparison of TFP growth rates for the Bell System with those of independent telephone companies is instructive in that: (i) the Bell System included

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[21] Federal Communications Commission, Primer and Sourcebook on Telephone Price Indexes and Rate Levels by James L. Lande and Peyton L. Wynns, Industry Analysis Division, Common Carrier Bureau (April 1987).

[22] Testimony of L.R. Christensen in United States v. AT&T, Civil Action No. 74-1698 (D.D.C.), Defendant's Exhibit D-T-128.

interexchange long distance service, while independent telephone companies were limited to local exchange service during this period, and (ii) independent telephone companies tended to have different physical characteristics than Bell companies. Christensen's results suggest that local exchange productivity growth during this period is less than long distance TFP growth and/or that independent telephone company TFP growth is less than that of the Bell companies.

(6) Summary

The available pre-divestiture data provide no support whatever for the Commission's assumption that technological progress grew equally rapidly in the local exchange and long distance sectors. On the contrary, the evidence suggests that productivity grew much more rapidly in the long-distance sector. Hence, aggregate growth of productivity in telecommunications of 2.5% is most likely an average of long distance productivity, which substantially exceeded 2.5% per year, and local exchange productivity, which was considerably less than 2.5% per year. The pre-divestiture data provide no evidence on which the Commission could justify mandatory price caps with a productivity factor of 2.5% for LECs, or for Cincinnati Bell in particular.

E. Post-Divestiture Productivity Analysis

(1) Introduction

The post-divestiture data also do not support the reasonableness of the Commission's proposed productivity factor of 2.5% per year. On the contrary, the data suggest that such a factor is overly ambitious.

(2) Analysis of Post-Divestiture Prices of LECs

The Commission proposes to use a single productivity factor for all LECs. That factor is based on aggregate industry data and would be binding on all Tier 1 carriers. This approach is inappropriate for mandatory price caps, because there are substantial differences among Tier 1 carriers. In particular, Cincinnati Bell differs markedly from the RBOCs, which dominate all aggregate industry data, since they constitute over two-thirds of the LEC industry.[23]

In an analysis of LEC industry productivity for the post-divestiture period, Bellcore estimated the difference between the productivity of RBOCs and that of independents.[24] The study filed on August 18, 1988 reported productivity, or "X" factors, of .67% for the aggregate of the seven RBOCs and -3.43% for the remainder of the industry, the independents. A later filing, made in September of 1988, included some corrections in methodology which further widened the gap between RBOC and independent productivity. The revised calculation reflected an RBOC-specific factor of .62% and a total industry average of -0.7%. Applying the same weights as in the previous study implies a non-RBOC factor of -4.3%, yielding a difference between the two sets of about 5%.

This differential can be explained in several ways. One is that the independents did not experience the same diseconomies of scale (inefficiencies) prior to divestiture that the RBOCs did. The independents tend to operate under a different cost structure,

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[23] The relative weights for RBOC and non-RBOCs in the LEC industry that were used in the Bellcore study are 73% and 27%, respectively. Bellcore, "The Impact of the FCC Proposed Price Cap Plan on Interstate Consumers," (August 18, 1988).

[24] Ibid.

management structure, and set of incentives than do the RBOCs. The independents' cost structure is affected by their different size, and their management style by a tendency to be centralized, in contrast to the disperse management of AT&T before the breakup. After divestiture occurred, some of the Bell System's inefficiencies were reduced through major force reductions and reorganizations to meet the new environment. These one-time improvements in efficiency were realized only by the RBOCs.

F. Likely Future Developments

Prices of interstate services have declined substantially during the post divestiture period. Residential toll rates, for example, declined by 38%.[25] These reductions resulted primarily from the FCC's access charging plan, under which increasing amounts of non-traffic sensitive costs (NTS) have been defrayed by subscriber line charges. At the same time, the fraction of NTS costs allocated to the interstate jurisdiction has declined as the gross allocator has declined toward 25%.

As long-distance prices have declined, demand has been greatly stimulated. The stimulation, in turn, has greatly improved the productivity of LECs, because many costs of LECs do not increase proportionately with demand. Indeed, NTS costs do not increase at all with traffic.

In the future, long-distance prices are likely to decline much more slowly, if at all. No further increases in the SLC are contemplated and the implementation of SLCs has been the single largest factor in the post-divestiture decline in access and toll rates. A

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[25] Federal Communications Commission, Monitoring Report, CC Docket 87-339, prepared by the Staff of the Federal-State Joint Board in CC Docket No. 80-286 (December 1988).

number of other Commission actions which lowered rates between 1984 and 1988 are unlikely to be repeated: the phase-down of the CPE and inside wire accounts will have a much smaller effect in the future, the transition of SPF to the gross allocator is nearly complete on average, a rate of return represcription is unlikely under a price cap regime, and tax reform is unlikely to yield further reductions in the corporate tax rate. Indeed, the corporate tax rate may well increase. Although the effects on individual LECs of these changes in interstate costs are likely to be different, the effect on toll rates is the same because interstate toll rates are geographically averaged.

Consequently, demand will be stimulated much less and productivity is likely to increase much more slowly. The Commission does not appear to have taken adequate account of this likely reduction in productivity in setting its productivity factor.

IV. CONCLUSIONS

A mandatory price cap plan, with an established 2.5% productivity factor, is unfair to some LECs, and particularly to Cincinnati Bell. It has been shown that although Cincinnati Bell operations are efficient, the company has enjoyed productivity gains lower than the RBOCs, and therefore should not be held to that standard. Moreover, the estimate of the proposed industry standard of 2.5% is probably too high.

The LECs have not enjoyed many benefits of technology that allowed AT&T to have such rapid productivity increases in the pre-divestiture years. Finally, incentive regulation should be voluntary, rather than mandatory. Since it is difficult to ascertain exactly what is the best estimate of LEC productivity, and because each LEC faces entirely different circumstances which will affect its productivity, each individual LEC should be

allowed to choose whether to participate or not. This decision will then be based on an assessment of those individual circumstances faced by the company, which only the company can properly judge. Only then will the result be an improved regulatory system for consumers, as well as for the LECs, and their shareholders.

Appendix A

Cincinnati Bell Telephone's Total Factor Productivity Study (72-80)

TOTAL FACTOR PRODUCTIVITY ANALYSIS
CINCINNATI BELL TELEPHONE

The term "Productivity" in economics refers to ratios of outputs to inputs, defined in physical terms or the equivalent. The Productivity Analysis is intended to shed light upon the productive process in the firm. In practice, the productivity concept refers to the change in the output-input ratio over time, rather than to the ratio itself.

The measure of output we use is based on deflated revenues. This is accomplished by adjusting the revenue for rate changes and subtracting property and other non-income taxes, whose variations cannot be identified with any particular input in the production process. Materials, rents, and services are also subtracted.

The Labor Input Series is based on a direct physical measure of employee hours worked and charged to Expense. Employee hours of different occupations and seniority levels are assigned different fixed weights to reflect their different contributions to output. Thus, changes in the aggregate weighted employee hours over time reflect changes in the occupational-seniority mix as well as changes in the overall quantity of hours worked. The adjusted aggregate hours are multiplied by their average unit price in base year - Total Employment Cost charged to Expense in the Base Year (1972) per Employee Hour - to derive the Labor Input component of the total input in accordance with the definition of Total Factor Productivity.

The Capital Input is viewed as the capital cost required for production over a given period of time. The aggregate of those assets, defined as the capital stock, includes tangibles (Plant) and financial assets or working capital (cash, net receivables and inventories). All components of the capital stock are expressed in prices of the base year (1972). With respect to the plant investment, this means that the amounts remaining on the books from each annual vintage of capital are repriced to a 1972 price level. The capital stock each year is multiplied by its 1972 unit price - the rate of earnings before income taxes in the base year - to derive the annual carrying charge on the capital stock at the base year rate. To the extent that the rate of return in the base year is considered a proper indicator of the best alternative return for the assets if put into use elsewhere, the dollar figures of the Capital Input Series can be interpreted as the opportunity cost of employing the assets in the service of Cincinnati Bell if the base year earnings opportunities had prevailed over the years. The fluctuations in the derived Capital Input Series reflect the variations in the real assets tied up by the production process, since the capital stock has been priced at a constant rate of return.

Materials, rents and services purchased are also adjusted for price changes and expressed in base year dollars. They are netted out in computing the output.

The primary objective of Total Factor Procutivity Indexes is to provide measures of the trend of overall productive efficiency in the utilization of given resources. Whatever the reason for such variations in productive efficiency, their measurement is important for the following reasons:

(1) Computations of Total Factor Productivity Indexes over time point to trends in the productive efficiency of the Company. Productivity gains are normally a significant source of increased benefits to stockholder, employees, and customers. Productivity trends thus have a bearing on the most important aspects of Company performance, such as its prices, the rate of return to stockholders, the quality and morale of its human organization, customer loyalty, etc. Productivity variations may provide clues to some of the reasons behind the improvement or deterioration in key aspects of Company performance.

(2) Measures of Total Factor Productivity over time may be used for comparison with similar measures for the economy as a whole, as a starting point for analysing the underlying productive characteristics of business or industry. However, such comparisons with other enterprises or other industries are usually of limited value, even for firms in the same industry because of the wide differences in markets or areas of operation, mix of output or customers, climatic conditions, and so on. It should also be stressed that the past efficiency level may also have an important effect on productivity growth at any given time, and can cause differences in productivity performance among companies.

(3) Past productivity figures may be used as bases for forecasting future trends, for setting productivity goals or improving business performance. These forecasts or goals can provide information relating to such important questions as (a) the extent to which productivity gains might offset rising costs and permit a flexible pricing policy, or (b) the labor and capital resources that would be needed to produce a given volume of output. Reliable productivity forecasts can therefore play an important role in corporate planning.

(4) A productivity data base opens new important avenues of research into factors affecting productivity and the formulation and estimation of production and cost functions, which can contribute to our knowledge of the basic economic characteristics of the business.

(5) Productivity measures can have potential regulatory applications. The issue of a productivity offset to increasing costs has been an important one in some rate cases, and productivity measures can be helpful in the study of this question.

Cincinnati Bell Total Factor Productivity

Gross Value - Added Version

(Base Year 1972)

I. Rate Adjusted/Constant Year (Dollars in Thousands)

	Input	Labor	Capital	Output
72	$109,363.6	$53,931.2	$55,432.4	$109,363.6
73	112,521.4	54,720.7	57,800.0	118,413.8
74	115,434.0	55,130.8	60,303.2	123,924.5
75	112,990.2	50,767.9	62,222.3	129,101.0
76	115,566.8	51,831.5	63,735.4	136,124.1
77	118,049.4	52,431.8	65,617.6	141,159.4
78	124,592.4	56,354.7	68,237.7	152,556.4
79	130,899.2	60,578.5	70,320.7	168,142.6
80	136,447.7	63,254.2	73,193.5	179,287.2

	Booked Revenues	Materials, Rents and Services	Property Tax	Other Non-Income Taxes
72	$136,499.5	$15,535.3	$8,367.2	$3,233.4
73	145,390.0	14,838.6	8,713.7	3,423.8
74	153,594.2	17,012.0	9,088.8	3,568.9
75	159,105.2	16,936.1	9,385.7	3,682.3
76	167,862.4	18,242.8	9,614.5	3,881.0
77	176,157.0	21,105.7	9,875.2	4,016.7
78	190,563.6	23,483.9	10,247.8	4,275.4
79	207,870.9	24,611.4	10,548.6	4,568.4
80	219,316.9	24,316.0	10,957.1	4,756.6

II. Yearly Precent Increase

	Input	Labor	Capital	Output
73	2.89	1.46	4.27	8.28
74	2.59	.75	4.33	4.65
75	-2.12	-7.91	3.18	4.18
76	2.28	2.10	2.43	5.44
77	2.15	1.16	2.95	3.70
78	5.54	7.48	3.99	8.07
79	5.06	7.50	3.05	10.22
80	4.24	4.42	4.08	6.63

	Booked Revenues	Materials, Rents and Services	Property Tax	Other Non-Income Taxes
73	6.51	-4.48	4.14	5.89
74	5.64	14.65	4.30	4.24
75	3.59	-.45	3.27	3.18
76	5.50	7.71	2.44	5.39
77	4.94	15.69	2.71	3.50
78	8.18	11.27	3.77	6.44
79	9.08	4.80	2.93	6.85
80	5.51	-1.20	3.87	4.12

III. Ratios

	Output Per Unit of Capital	Output Per Unit of Labor	Capital Per Unit of Labor
72	1.97	2.03	1.03
73	2.05	2.16	1.06
74	2.06	2.25	1.09
75	2.07	2.54	1.23
76	2.14	2.63	1.23
77	2.15	2.69	1.25
78	2.24	2.71	1.21
79	2.40	2.78	1.16
80	2.45	2.83	1.16

IV. Total Factor Productivity

		Annual Percent Increase
72	1.00	
73	1.05	5.24
74	1.07	2.01
75	1.14	6.43
76	1.18	3.09
77	1.20	1.52
78	1.22	2.40
79	1.28	4.91
80	1.31	2.29
Average Annual Growth Rate 1972-1980		3.49 *

* By comparison, Bell System productivity growth was 4.9 percent per year from 1972 to 1979.

Appendix B

Cincinnati Bell Telephone Pre-divestiture Productivity: Three-factor Model

The pre-divestiture Cincinnati Bell study which calculated the Total Factor Productivity (TFP) from 1972 through 1980 used the Gross Value Added method. However, it is widely believed that the Total Value Added method is a better indicator of productivity when analyzing company specific data. The advantages are discussed in detail in Appendix D. Thus, the TFP for Cincinnati Bell was recalculated using the Total Value Added method. This computation is shown in Table 1.

Cincinnati Bell's TFP was calculated for the years 1972 through 1979. The aggregate increase in productivity for this time period was 23.95%, which is an average rate of 3.1% per year. This can be compared to Bell System productivity of 4.2% per year (three-factor model).

TABLE 1

TOTAL FACTOR PRODUCTIVITY CALCULATION
(TOTAL OUTPUT METHOD)
(1972 DOLLARS)

	1972	1979
Total Deflated Revenues	136,499,500	207,870,900
Non-Income Taxes	11,600,600	15,117,000
Total Output	124,898,900	192,753,900
Total Labor Input	53,931,200	60,578,500
Total M,R, & S Input	15,535,300	24,611,400
Total Capital Input	55,432,400	70,320,700
Total Input	124,898,900	155,510,600
TFP	1.0000	1.2395
Productivity (% Change in TFP)		23.95%
Avg. Productivity/Year		3.1147 *

* *This can be compared to Bell System productivity of 4.2% per year (total output method).*

Appendix C

Total Factor Productivity of Interstate Access Services

Cincinnati Bell Telephone Company

This study estimates the rate of change in total factor productivity (TFP) for the interstate access services of Cincinnati Bell Telephone Company (CBT) from 1984 to 1988. The method is based on comparing the rate of growth of CBT interstate output prices to the rate of growth of output prices for the U.S. economy as a whole. Under appropriate conditions, the difference between these rates of growth equals the difference between the CBT change in TFP and the change in TFP for U.S. industry as a whole. Using data from CBT interstate access filings in 1984 and 1988, we estimate CBT's annual rate of growth in TFP for all interstate access services to be 0.32% greater than the national TFP implicit in the GNP-PI deflator. During this period, TFP as measured by the Bureau of Labor Statistics for U.S. private business grew at an annual rate of 1.07%, so that the implied TFP growth for Cincinnati Bell's interstate services was approximately 1.38% per year.

1. Methodology

The level of total factor productivity -- by definition -- is simply the observed ratio of an index of the physical quantity of outputs to an index of the physical quantity of inputs, and it can be measured by the ratio of an output quantity index to an input quantity index for a given year. Productivity change is the annual change in that ratio.

There are two generic types of total factor productivity studies performed in the literature: direct and indirect. A direct TFP study explicitly calculates output and input quantity indices and measures the rate of growth of TFP by the growth of their ratio.

Two-factor TFP studies measure the change in labor and capital per unit of gross value added (total output less intermediate goods and services). Three-factor TFP studies measure the change in labor, capital, and intermediate goods and services per unit of total output. Since the latter measure treats improvements in the use of intermediate products as part of total factor productivity change while the two-factor measure does not, a three-factor TFP study will produce smaller average TFP growth than a two-factor study whenever output per unit of intermediate goods is growing more slowly than output per unit of labor and capital. For the communications industry and for U.S. industry as a whole, three-factor TFP measurements are smaller than the corresponding two-factor measurements.

Indirect TFP studies base an estimate of TFP change on the rate of change of output prices. By definition, the rate of change in output prices for a firm or an industry is equal to the change in its input prices (including exogenous changes in costs) less the change in its total factor productivity:

$$(1) \qquad TO = [TI + TZ] - TTFP$$

where TO represents the annual percentage change in the telecommunications industry (or firm) output prices, TI represents the annual percentage change in its input prices, TTFP represents the annual percentage change in its total factor productivity (the ratio of an index of physical quantities of outputs to an index of physical quantities of inputs), and TZ represents changes in costs due to external circumstances (e.g., tax rate changes) expressed as a percentage of total cost. Equation (1) is derived by differentiating the accounting identity that profits equal revenue less costs; the only assumption necessary to derive this relationship is thus that the change in industry profits is zero over time.

There is no convenient measure of the telecommunications industry's change in input prices, so some further simplification is necessary if we are to be able to apply the formula. Since telecommunications firms purchase labor, raw materials, and capital in national markets, it is reasonable to assume that the change in telecommunications input prices is similar to the change in input prices throughout the economy. Evidence supporting this assumption was presented by Dr. Laurits Christensen in Appendix F of AT&T's Comments in response to the FCC's Notice of Proposed Rulemaking in CC Docket 87-313, filed October 19, 1987. According to Dr. Christensen's calculations, input cost inflation for the Bell System and for the total U.S. private domestic economy averaged 4.5% and 4.6% respectively for the years 1948 through 1979. Assuming further that there are no changes in excess profits in the economy as a whole, equation (1) can be derived for the nation as a whole in the same manner as it was derived above:

$$(2) \qquad NO = [NI + NZ] - NTFP$$

where NO is the annual change in a national index of output prices, NI is the annual change in a national index of input prices, NTFP is the annual change in the economy-wide total factor productivity, and NZ represents exogenous cost changes expressed as a fraction of total cost. Since NI = TI by assumption, (substantiated by Dr. Christensen's findings), substituting equation (2) into equation (1) and replacing NI by TI, we see that

$$(3) \qquad TO = NO - [TTFP-NTFP] + [TZ-NZ].$$

In words, the change in the average output price for an industry or a firm is equal to (i) the change in a national index of output prices less (ii) the difference between the change in total factor productivity for the industry or firm and for the nation as a whole, plus (iii) the difference between the effect of exogenous cost changes in the industry or firm and the

nation as a whole. This equation also defines the appropriate annual adjustment for a price cap index: output prices are constrained to grow no faster than an index of national output prices, less adjustments for differential changes in TFP and differential exogenous cost changes.

For ascertaining the appropriate productivity offset for a price cap adjustment formula, the indirect method of estimating TFP changes has some clear advantages. First, our concern is to estimate the rate of TFP change for certain interstate services of Cincinnati Bell. Using the direct method would require separating costs into an interstate and intrastate component, and, within the interstate component, identifying costs associated with the provision of carrier common line service, switched traffic sensitive access service, and special access service. Given the large proportion of common costs among access services, a direct TFP study at the service level would be hazardous.

Second, while there is some independent interest in calculating TFP growth for access services, the primary use of the estimate is to determine an appropriate productivity offset for the FCC's price cap plan. For this purpose, the estimate of TFP growth should be consistent with use of TFP in the price cap plan in the following senses: (i) it should track the experience a firm would have had from 1984 to 1988 had price caps been introduced in 1984; and (ii) it should be measured relative to the TFP growth implicit in the GNP-PI deflator, as in equation (3).

In this study, we use the indirect method of calculating growth in TFP. We divide Cincinnati Bell's interstate access services into 3 baskets: common line (CL), switched traffic sensitive (TS) and special access (SA). For each basket, we calculate the rate of growth of an output price index between 1984 and 1988, adjusting the 1988 prices to

account for exogenous changes in costs which would have been automatically passed through to customers in higher prices under the price cap plan. Price data was taken from Cincinnati Bell's interstate access filings for the years in question, as amended, corrected, and implemented by FCC Orders.

Prices were calculated by dividing the Part 69 filed and corrected revenue requirements for common line, switched access, and special access elements by the appropriate measure of (filed and corrected) demand. For CL and TS, the demand measure used was CL and TS access minutes, respectively. For special access, the demand index used was the number of voice-grade equivalent channel terminations; if all special access outputs were proportional to the number of channel terminations use of this index would involve no approximation.

2. Exogenous Cost Change Adjustments

An artificial cause of changes in interstate access charges has been significant changes in ratemaking rules, including separations changes. Since 1984, these changes have tended to reduce interstate switched access revenue requirements for Cincinnati Bell but it would be incorrect to include their effects in a TFP study. First, they do not represent an increase in the physical measure of TFP, and second, these cost changes would be passed through directly in lower access charges under the price cap plan proposed in the Second Further Notice.

Ten exogenous cost adjustments were identified in the Bellcore study, and the amounts of those adjustments for Cincinnati Bell, assigned to CL, TS, and SA are given below in Table 2.1.

Table 2.1
Historical Z adjustments
ANNUAL CHANGES - $000
Cincinnati Bell

	CL	TS	SA	NA	TOTAL
CPE	($2,458)	-	($ 53)	-	($2,511)
SPF	($2,564)	-	-	-	($2,564)
ISW	($5,813)	-	($125)	-	($5,938)
WATS DA	($2,105)	($2,111)	$6,475	$ 288	$2,546
ACCOUNT 645	$ 71	$ 61	$ 17	$ 347	$ 497
ROR	($ 732)	($730)	($454)	-	($1,916)
TAX REFORM	($1,921)	($1,915)	($1,191)	-	($5,028)
RDA	$2,331	$2,323	$1,445	-	$6,099
PENSION	-	-	-	-	-
PART 32	$1,651	$1,558	$2,903	-	$6,112
TOTAL	($11,541)	($ 814)	$9,017	$ 635	($2,703)

These adjustments were made to revenue requirements in 1988 so that the growth in access rates between 1984 and 1988 would be calculated as if these changes had not occurred. Note that one of these changes, WATS DA, involves changes in both revenue requirements and demand volumes. The effect of demand shifts among interstate access services must be neutral with respect to the change in TFP for interstate access as a whole, and the only net effect of the WATS DA adjustment is the $2.5 million aggregate increase in interstate revenue requirements.

3. TFP Change for Common Line

As described in the Bellcore study, the rate of TFP change since divestiture is measured by dividing the entire common line revenue requirement by demand in 1984 and

in 1988, adjusting the 1988 price to remove the effect of exogenous cost changes outlined above, and calculating the annual rate of growth of the adjusted common line price. The rate of growth of TFP for the CL basket is thus given by the rate of growth of the common line revenue requirement per CL minute of use, adjusted as if exogenous changes in costs had not occurred. This calculation is shown in Table 3.1 below.

If the exogenous cost changes outlined in Table 2.1 had not occurred, the CBT CL rate would have increased over the period from $0.0317 to $0.0350 per minute of use. Note that this rate is not the tariffed carrier common line charge in the tariffs of Cincinnati Bell because (i) the CL revenue requirement above includes the end user common line revenue requirement which was recovered from subscriber line charges during this period, and (ii) the CL revenue requirement and revenues were pooled among all local exchange carriers through the mandatory NECA CL pool.

Table 3.1
Cincinnati Bell CL Access Rates
1984 and 1988

1984		
(1)	Adj CL Filed Rev Req	$35.571 M
(2)	CL Filed Demand	1,057.763 M
(3)	CL Rate	$0.0317
1988		
(4)	Cost-Adj CL Filed Rev Req	$ 44.969 M
(5)	CL Demand	1,286.029 M
(6)	Adjusted CBT CL Rate	$0.0350

Thus the tariffed rates for Cincinnati Bell reflected national average revenue requirements and demand; had we based a TFP study on the tariffed rates, it would not be applicable to CBT's experience.

The growth rate of the above CL access charges (adjusted for exogenous cost changes) is thus approximately 2.84% per year.[1] Since the GNP-PI price index was growing at 3.24% per year during this period, the rate of growth of CBT TFP, relative to national TFP, is 0.40% (= 3.24 - 2.84), using the formula in equation (3) above. The BLS two factor TFP study for U.S. private business over this period found U.S. TFP to be growing at 1.07%, so the implicit annual change in CBT TFP is 1.47% (= 0.40 + 1.07). One interpretation of this result is that CBT TFP grew 0.40% faster than the national average TFP, so that 0.40% would be an appropriate productivity offset, [TTFP-NTFP], in a price cap adjustment formula such as equation (3). A second interpretation is that 0.40% is the value of the productivity offset which -- if applied in a price cap adjustment factor between 1984 and 1988 -- would cause prices to change by roughly the amount by which they actually changed over that period. Thus, if the price cap adjustment formula for the common line basket were given by equation (3) and [TTFP-NTFP] were set equal to 0.40%, the common line price would change at just the rate at which it was observed to change under rate of return regulation between 1984 and 1988.

Note that while this is a direct application of the indirect method of calculating TFP from output prices, it does not apply to the price cap formula proposed for the CL basket in the Second Further Notice. This plan proposes to discount TFP growth due to

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[1] Using geometric growth, the formula used was [((1988 adjusted CL rate)/(1984 CL rate))^(2/7)]-1.

economies of scale for the CL element by using an average of the adjustment factors which would apply on a per-line and a per-minute basis. To calculate the productivity offset in the price cap adjustment formula correctly for this plan, we must take into account the fact that something in excess of the full pass through of changes in TFP will be applied. Below, we estimate the level of the productivity offset, which -- if used in the proposed formula for the price cap adjustment factor and applied to data from 1984 to 1988 -- would produce the price change actually observed over that period.

The productivity offset calculated on a loop basis is that factor X for which [GNP-PI - X] grows at the same rate as NTS costs per line. This calculation is easily adopted from Table 3.1. The resulting annual rate of growth of (per loop) CL rates is 4.1%, so that the corresponding value of the productivity adjustment would be -0.86% per year. The proposed treatment of CL productivity in the Second Further Notice is to average the productivity adjustments calculated per minute and per line; that requirement, for Cincinnati Bell, would yield a productivity adjustment factor of -0.23% (= [0.40 - 0.86]/2).

Table 3.2
Cincinnati Bell CL Access Rates per Line
1984 and 1988

1984		
(1)	Adjusted CL Rev Req	$35.571 M
(2)	CL Filed Demand	620,000 loops
(3)	CL Rate	$ 57.37 per loop per year
1988		
(4)	Adjusted CL Rev Req	$44.969 M
(5)	CL Demand	681,000 loops
(6)	Adjusted CBT CL Rate	$66.03 per loop per year

That is, if Cincinnati Bell's CL rates had been regulated since 1984 under a price cap formula as proposed in the Second Further Notice, a productivity adjustment of -0.23% would be necessary for its 1988 CL rate to equal its observed rate under rate of return regulation.

4. TFP Change for Traffic Sensitive Switched Services

The calculation for TS is identical to the CL calculation discussed above. Rates for the TS element were calculated by dividing the entire TS switched access revenue requirement by the number of TS minutes of use. Details of the calculation are present in Table 4.1 below.

Table 4.1
Cincinnati Bell TS Switched Access Rates
1984 and 1988

1984		
(1)	TS Filed Rev Req	$24.918 M
(2)	Disallowance	$0.00
(3)	Net TS Rev Req	$24.918 M
(4)	TS Filed Demand	1,057.763 M
(5)	TS Rate	$0.0222
1988		
(6)	TS Rev Req	$34.672 M
(7)	TS Demand	1,452.674 M
(8)	CBT TS Rate	$0.0239
(9)	Disallowance/MOU	-
(10)	Z adjustments/MOU	($0.0005)
(11)	Adjusted CBT TS Rate	$0.0244

The associated annual rate of growth is 2.72% which results in a TFP annual growth rate, relative to the national average, of 0.52%. In absolute terms, TFP grew for Cincinnati Bell's interstate TS switched access service at an annual rate of 1.59%.

5. TFP Change for Special Access

The same basic methods as used above are applied in this section to estimate the rate of growth of TFP for interstate special access as a category. We take the earliest and latest dates for which special access rates were permitted to into effect (April 1985 and January 1988, respectively), calculate a price index for special access services at those dates, adjust the 1988 value of the index for exogenous cost changes, calculate the rate of growth of the adjusted price series, and subtract that rate of growth from the rate of growth of the GNP-PI over the same period. We note that our index of special access demand -- voice-grade equivalent channel terminations -- is the same as that used in the Bellcore study.[2]

[2] The use of voice-grade channel terminations in that study has been criticized because it ignores: (i) the shift in the proportion of 2-wire to 4-wire channel terminations during the period, and (ii) a shift in the proportion of channel termination costs to total special access costs. Neither of these shifts has any bearing on the accuracy of channel terminations as an index of special access output. What is required of this index is that the quantity of special access outputs (alarm circuits, channel mileage circuits, conditioning and signalling, video circuits, etc.) move in proportion with voice-grade equivalent channel terminations. The price change measured is not the price of voice-grade channel terminations but the ratio of total special access revenue requirements to the number of channel terminations.

Table 5.1
Cincinnati Bell 1985-1988 Implemented Special Access Revenue Requirements, Demand, and Rates

		1985 ($ M)	1988 ($ M)
(1)	Cost-Adjusted Rev Req	$ 16.153	$ 19.026
(2)	VG CTs	27,328	22,542
(3)	DS-1 CTs	16	900
	REV REQ/CT	**($/month)**	**($/month)**
(4)	VG	$49.03	$53.44
(5)	DS-1	$16.18	$17.64

The associated annual rate of growth of revenue requirements per channel termination is 3.18% which results in a TFP annual growth rate approximately equal to the national average. In absolute terms, TFP grew for Cincinnati Bell's interstate TS switched access service at an annual rate of 1.07%.

6. TFP Change For CBT Interstate Access

The proposed price cap plan contemplates a single productivity offset for each of the three baskets discussed above. To calculate an average growth rate for CL, TS, and SA rates, we form a Laspeyres and Paasche aggregate price index and calculate its rate of growth. Thus, if a single productivity offset were to be used in all three baskets in the proposed price cap plan, the value of that offset that would just reproduce the price changes actually experienced since 1984 is 0.32%.

Table 6.1
CBT Aggregate Access Rates
1984 and 1988

	Common Line	Switched TS	Special Access
1984			
Rate	$0.0317	$0.0222	$ 570
Demand	1,057.763 M	1,057.763 M	26,691
Revenue	$33.535 M	$23.492 M	$ 15.219 M
1985			
Rate	-	-	$ 588
Demand	-	-	27,455
Revenue	-	-	$ 16.153 M
1988			
Rate	$0.0350	$0.0244	$ 641
Demand	1,286.029 M	1,539.307 M	29,670
Revenue	$44.969 M	$37.554 M	$19.027 M
Laspeyres	1.1061		
Paasche	1.1053		
Annual Growth		2.9%	
Relative TFP Change		0.32%	

Appendix D

Cincinnati Bell's Total Factor Productivity: 1984-1988

In order to see how Cincinnati Bell Telephone would have fared under price caps with a productivity factor, this study measures the Total Factor Productivity (TFP) for the post-divestiture years for CBT. Productivity is the ratio of total outputs to total inputs. In analyzing productivity over time, one looks at the change in the productivity ratio from year to year. Hence in this study, productivity will refer to the percent change in the TFP.

This study used the Cincinnati Bell study from 1984 through 1991 on TFP as a foundation, and recalculated certain components of the study. This study also reviewed the Bell System "Productivity Study 1947-1979" to examine any differences in methodology with the Cincinnati Bell study.

This study demonstrates that the productivity that Cincinnati Bell experienced for the period 1984 through 1988 was less than the FCC's proposed 2.5% productivity mark. The actual productivity improvement was approximately equal to the economy-wide improvement in productivity.

There are two major differences in the approach this study took from the Cincinnati Bell study in calculating Total Factor Productivity. First, the Total-Output method is used instead of the Gross Value Added method. The Total-Output method, also known as the three-factor input method, differs from the Gross Value Added method by counting Materials, Rents, and Services as a third input category instead of deducting this amount from revenues on the output side. In this method, non-income taxes are the only deductions made from revenues to calculate total output. Under the Gross Value Added

method, there is an implicit assumption of no productivity gain in Materials, Rents, and Services. Thus, this approach does not allow for productivity improvements in purchase decisions and the efficiency of employing these assets. The three factor approach allows for such productivity improvements. The Total Output method is more appropriate in appraising the TFP for individual companies.[1] In examining industry wide productivity, the Gross Value Added method is more appropriate because the Total Output would double count inter-industry purchases and sales of Materials, Rents, and Services.

The second major change in methodology from the Cincinnati Bell study is that non-income taxes are deflated (using the GNP deflator). In addition, a more reasonable interstate access price index is used. The price indices used for individual services are shown in Table 1 along with the actual 1988 revenues and deflated revenues. The price indices for all services are 1 in the base year 1984. The interstate price index is calculated in Appendix C. Also, this study only calculates total productivity improvement rates from 1984 through 1988.[2]

The capital input was calculated in the same manner as the Cincinnati Bell study. The capital input was calculated by taking earnings including income taxes, interest, and depreciation in the base year and dividing by the total stock of capital valued in base year dollars. This results in the computation of the rate of return on capital. This is shown in Table 2. This rate of return is then applied to the capital stock in 1988 to obtain the capital input for 1988. The earnings before income taxes, interest and depreciation

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[1] See p. 5 of the Bell System "Productivity Study 1947-1979."

[2] The actual 1988 data were not available, and thus we used projected data for 1988. We believe that these should approximate actual 1988 data well since the estimates were made during the 1988 year.

expenses are deducted are calculated by taking total revenues and subtracting out non-income taxes, materials, rents, and services, and labor input. This method would assure a total factor productivity of 1 in the base year because the earnings are considered the return of capital in the base year. The capital stock is computed by taking the book value of the average plant in service and inflating it to the reproduction cost of the plant in the base year. This is accomplished by using the Telephone Plant Index. The average plant in service (net book investment) is multiplied by the ratio of end of year deflated age distribution of plant (real value) to the end of year age distribution of plant in service (nominal value) to obtain the replacement cost of plant in service. Current assets, average plant under construction, and miscellaneous physical property are added to the replacement cost of plant to obtain total stock of capital.

The Bell System "Productivity Study 1947-1979" was used as a basis for comparison with the Cincinnati Bell Study. It was found that the methodologies used in the Cincinnati Bell study are consistent with those used in the Bell System study. It should be noted that the Bell System study uses a finer level of disaggregation for some components of the total factor productivity than did the Cincinnati Bell study.[3]

Our study demonstrates that Cincinnati Bell experienced substantially less productivity gain than the FCC's proposed 2.5% productivity improvement under price caps. The results and calculation of the TFP and percent change in productivity is shown in Table 3. CBT had modest productivity gains from 1984 through 1988 with an average

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[3] The Bell System study uses a more physical measure of labor inputs by taking the total number of hours actually worked and weighting these hours by occupational category and years of service within each category. The Bell System study also accounts for changes in the tax laws by using the fixed rates of non-income taxes in the base year and applying these rates in the subsequent years.

productivity gain of 1.92% per year. This can be compared to economy-wide productivity gains of 1.5% per year (from 1984 to 1987) according to the U.S. Bureau of Labor Statistics and 2.3% per year according to the American Productivity Center.

Percentage changes in the output and the three input components are shown in Table 4. As can be seen from Table 4, the productivity improvement for the period 1984 through 1988 resulted from a decrease in total inputs with a smaller decrease in total output. Output decreased at an average rate per year of .29%, while total inputs decreased at a yearly rate of 2.17%. Most of the decrease in total inputs can be attributable to labor input. Labor input decreased at an average rate per year of 4.35%, while capital input decreased at an average rate per year of 1.22% and materials, rents, and services remained relatively unchanged.

TABLE 1

PRICE INDEXES AND DEFLATED REVENUES

	1988	1988 Rev.	1988 Defl. Rev.
Subscriber Station	1.0789	228,181,000	211,486,395
Public Telephone	1.0032	11,493,000	11,456,340
Local Private Line	1.1309	10,482,000	9,268,492
Other Local Service	1.3314	2,257,000	1,695,208
Total LDI Access	1.1061	90,956,264	82,231,502
Total LDS CCL	1.0000	15,385,005	15,385,005
Total LDS Switched	1.0096	13,634,995	13,505,343
Total LDS Special	1.2955	1,766,747	1,363,757
Total Accounts 510-516	1.0057	34,670,570	34,475,500
Directory Adv.	1.2686	25,500,000	20,100,520
LDI B&C	1.0805	14,877,000	13,768,626
Other Misc.	1.1068	23,465,000	21,200,759
TOTAL		$472,668,581	$435,937,447

TABLE 2

CALCULATION OF RATE OF RETURN ON CAPITAL

YEAR	1984
TOTAL REVENUES	438,864,593
NON-INCOME TAXES	36,390,677
MAT'L, RENTS, & SVCS	67,432,645
LABOR INPUT	154,393,616
EARNINGS	180,647,655
PLANT IN SERVICE	996,871,461
CURRENT ASSETS	77,706,594
AVG TPUC	7,556,742
MISC PHYSICAL PROP	1,103,058
EOY AGE DIST'N. PLANT IN SVC.	1,009,277,311
EOY DEFL. AGE DIST'N. PLANT	1,829,406,206
TOTAL STOCK OF CAPITAL	1,893,285,877
RATE OF RETURN ON CAPITAL	9.5415%

TABLE 3

TOTAL FACTOR PRODUCTIVITY CALCULATION

	1984	1988
Total Revenues	438,864,593	472,668,581
Aggregate Price Index	1.0000	1.0843
Total Deflated Revenues	438,864,593	435,937,447
Non-Income Taxes	36,390,677	43,113,000
GNP Deflator	1.0000	1.1300
Deflated Non-Income Taxes	36,390,677	38,153,411
Total Output	402,473,916	397,784,036
Wages & Sal - Mgmt	55,726,280	52,549,000
Wages & Sal - Non-Mgmt	81,609,908	75,120,000
Mgmt Deflator	1.0300	1.1822
Non-Mgmt Deflator	1.0158	1.1595
Loadings Factor	1.2979	1.2979
Proportion Expense	0.9117	0.9117
% Regulated Employees	97.05%	100.00%
Total Labor Input	154,393,616	129,257,462
Mat'l, Rents, & Svcs	67,432,645	76,192,000
Total Defl. M,R, & S Input	67,432,645	67,427,103

(con't)

TABLE 3

TOTAL FACTOR PRODUCTIVITY CALCULATION

(con't)

	1984	1988
Avg. Plant in Service	996,871,461	1,083,256,000
Avg. Current Assets	77,706,594	91,234,000
Avg. TPUC	7,556,742	16,623,000
Misc. Physical Property	1,103,058	0
Deflated Non-Plant Assets	86,366,394	95,449,457
EOY Age Dist'n.		
Plant in Svc.	1,009,277,311	1
EOY Defl. Age Dist'n. Plant	1,829,406,206	1.5762
Avg. Plant in Service Adj.	1,806,919,483	1,707,428,107
Total Stock of Capital	1,893,285,877	1,802,877,564
ROR on Capital	9.54%	9.54%
Total Capital Input	180,647,655	172,021,356
Total Input	402,473,916	368,705,920
TFP	1.0000	1.0789
Productivity (% Change in TFP)		7.89%
Avg. Productivity/Year		1.9159% *

* *This number should be compared to economy-wide measures of productivity. From 1984 to 1987, economy-wide productivity increased 1.5% per year according to the U.S. Bureau of Labor Statistics and 2.3% per year according to the American Productivity Center.*

TABLE 4

PERCENT CHANGE IN OUTPUT, INPUT, AND PRODUCTIVITY

FROM 1984 THROUGH 1988

	1984 - 1988	AVG. / YEAR
% CHANGE TOTAL OUTPUT	- 1.165%	-0.293%
% CHANGE LABOR INPUT	-16.281%	-4.345%
% CHANGE M,R, & S INPUT	- 0.008%	-0.002%
% CHANGE CAPITAL INPUT	- 4.775%	-1.216%
% CHANGE TOTAL INPUT	- 8.390%	-2.167%
PRODUCTIVITY (% CHANGE IN TFP)	7.887%	1.916% *

* *This number should be compared to economy-wide measures of productivity. From 1984 to 1987, economy-wide productivity increased 1.5% per year according to the U.S. Bureau of Labor Statistics and 2.3% per year according to the American Productivity Center.*

ATTACHMENT E

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DIFFERENCES IN PRODUCTIVITY GAINS AMONG TELEPHONE COMPANIES

by

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DIFFERENCES IN PRODUCTIVITY GAINS AMONG TELEPHONE COMPANIES

Rate regulation of telephone companies seeks to promote charges to ratepayers which reflect the operations of a reasonably efficient carrier. A key issue in rate regulation is whether a particular carrier is achieving productivity gains in line with reasonable expectations.

This issue is complicated by the widespread belief that the differing operating conditions of carriers cause differences in the productivity gains that can be reasonably expected. Through quantitative economic analyses, the study described herein confirms that **expected productivity gains should be lower for smaller carriers and carriers with lower starting costs.** This finding is statistically significant.

There are various methods of rate regulation. NERA supports implementation of methods of rate regulation which depart from the traditional "cost-plus" approach. Alternative methods of rate regulation can provide earnings incentives to carriers which stimulate further productivity gains and innovative offerings. These methods can benefit consumers through lower rates and improved quality of services compared to the cost-plus approach. Yet, **these methods of rate regulation can achieve their maximum effectiveness only if they reflect the differences among carriers in the levels of productivity gains that can be reasonably expected.**

Price-cap plans adjust rates based on an economywide cost index (which reflects economywide productivity changes), an additional productivity adjustment (reflecting the reasonable expectation of additional gains by a particular carrier) and "exogenous" factors. Under these plans, smaller, lower-cost carriers should have a lower productivity adjustment than the level applied to the Bell Operating Companies (BOCs) and GTE. **This study estimates a reasonable productivity adjustment for Centel that is 1.5 percentage points below that of the BOCs and GTE.** Productivity adjustments for smaller, lower-cost carriers which fail to reflect these differences will cause these carriers to earn unreasonably low returns. Where the productivity adjustment is developed from analysis of the BOCs and GTE or an

industry average, smaller, lower-cost carriers may reasonably choose to be subject to the traditional method of rate regulation instead of a price-cap plan.

Another method of rate regulation ("shared earnings" or "banded rate of return" plans) establishes a zone of earnings that a carrier can retain without partial or full refunds to ratepayers. These plans should reflect the fact that productivity gains can be more easily achieved by larger, higher-cost carriers than by smaller, lower-cost carriers. A level of productivity gains yielding, for example, earnings 200 basis points above some prescribed level may represent above-average efforts by a larger, higher-cost carrier. But, the same level of productivity gains and earnings would correspond to truly extraordinary efforts by a smaller, lower-cost carrier. **In order to match rewards to accomplishments, the zone of potential retained earnings for smaller, lower-cost carriers should be higher (more potential for retained earnings) than the zone for larger, higher-cost carriers.**

Finally, this study also has important implications for cost-plus methods of rate regulation. Traditional rate-base/rate-of-return regulation incorporates the concern about reasonable productivity gains in determining whether particular investments and expenses are "imprudent" or not "used and useful," or whether overall cost levels are "excessive." In these determinations, regulators frequently use other carriers' performance as bench marks. This study finds that a shortfall in the productivity gains by a mid-sized, lower-cost carrier when compared against larger, higher-cost carriers can reasonably be expected in light of their differing operating conditions. If such a shortfall appears, it should not be taken as evidence that the smaller, lower-cost carrier is inefficient or poorly managed.

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DIFFERENCES IN PRODUCTIVITY GAINS AMONG TELEPHONE COMPANIES

I. INTRODUCTION

This study analyzes differences in productivity gains among local exchange telephone companies. The principal finding—expected productivity gains are lower for smaller carriers and carriers with lower starting costs—is important for rate regulation of telephone companies, under any of a variety of methodologies.

NERA supports implementation of a price-caps form of rate regulation for telephone companies with several different productivity adjustments reflecting the differences in expected productivity gains by the companies. In particular, the productivity adjustment applicable to smaller, lower-cost carriers should be substantially below the level applied to larger, higher-cost carriers.

As explained in the final section of this paper, the findings of this study are also important for forms of rate regulation involving "shared earnings" or "banded rate of return" plans as well as traditional rate-base/rate-of-return ("cost-plus") regulation. However, the following description will focus on price-caps plans because of the attractiveness of this form of rate regulation and the efforts by regulatory commissions to estimate expected productivity gains as a factor in such plans.

A. The Price Caps Order

The Federal Communications Commission (FCC or Commission), in its *Second Report and Order* on Price Cap Regulation for Local Exchange Carriers (LECs) (CC Docket No. 87-313; Adopted September 19, 1990, Released October 4, 1990), sought to benefit ratepayers by promoting economic efficiencies and innovative, high-quality service. Price-cap regulation sets a maximum limit on the price that a LEC may charge for service. Because the price limit is less than that expected under rate-of-return regulation, customers can benefit from lower rates. At the same time, companies are able to increase profits if they can cut costs and increase demand or offer new services, yielding more efficiency. The plan was implemented in January 1991. While the FCC decided that the plan would be mandatory for Regional Bell Operating Companies (RBOCs) and General Telephone Operating Companies (GTOCs), the plan is optional for all other LECs not participating in NECA pools.[1]

[1] LECs participating in NECA pools are not permitted to elect price-cap regulation.

These "other" LECs are allowed a once-a-year opportunity to elect price-cap regulation, but a positive decision to elect price caps is irrevocable.

The annual adjustment formula for the price-cap index incorporates adjustments for inflation, special common line formula adjustment, exogenous costs and a productivity offset. The productivity offset represents the amount by which the LECs are expected to outperform economy-wide productivity gains plus a 0.5 percent "consumer dividend." The productivity offset is set at 3.3 percent or 4.3 percent at the option of each company. Those companies electing 4.3 percent are permitted to retain higher rates of return before being required to share profits with ratepayers. The appropriateness of across-the-board application of the 3.3 percent (or 4.3 percent) to a heterogenous group of companies which may differ vastly in opportunities for productivity gains is the issue explored in this analysis.

B. Application to Small- and Mid-sized LECs

In its *Report and Order*, the Commission hesitated to conclude whether either overall or individual productivity factors were appropriate for small- and mid-sized LECs. The Commission stated that the independent LECs are too diverse in terms of geography, business organization, historical growth rate, customer and resource base (among others) to predict the entire class's productivity gains on the basis of documented evidence on productivity gains. As a result of this uncertainty, the Commission chose instead to develop a better record of whether and in what cases a lower productivity factor would be appropriate for small- and mid-sized LECs.

Many state public utilities commissions have adopted price caps or other "incentive regulation" plans. Most of these plans are applicable only to the largest carrier (typically the BOC) in a state. Like the FCC, state commissions have not faced the issue of estimating a separate productivity factor for small- and mid-sized LECs. The efforts by state commissions to improve on traditional cost-plus rate regulation are commendable and would benefit from this study's statistical analysis of differences in expected productivity gains among telephone companies.

In this regard, the historical differences in productivity gains between the larger LECs (the BOCs and GTE) and other LECs are of interest. These past productivity differences suggest that the BOC/GTE LECs and other LECs face significantly different circumstances which affect their respective abilities to increase productivity over the current level. Figure 1 depicts how the smaller, independent companies compare historically to the Bell and GTE companies. Figure 1 displays the mean difference in change in total factor

productivity by independent LECs from the mean change in total factor productivity by the Bell/GTE composite[2] over the post-divestiture period 1986 through 1988 (years for which consistent data were available).[3] As the figure shows, the productivity gains of Contel and SNET were very close to the BOC/GTE average. However, productivity gains of the other four LECs (including Centel) for which data are available were much less than the BOC/GTE average.[4] Although (as Spavins and Lande have observed[5]) there is substantial year-to-year variation in productivity gains,[6] these historical results suggest that the Commission's concerns about applying a uniform standard of productivity to LECs of all sizes and affiliations are well-founded.

The historic productivity gains shown in Figure 1 clearly depict why a company like Centel would view as unreasonable a price-cap plan with a productivity adjustment based on the BOC/GTE average. For purposes of making reasonable predictions of future productivity gains, economists develop statistical models from such historic data. The remainder of this paper presents the results of our quantitative study which develops such a predictive model.

The study demonstrates that differences in productivity gains among telephone companies have a statistically significant relationship to the carriers' size and cost level. Smaller, lower-cost carriers have lower levels of expected productivity gains than larger, higher-cost carriers. This finding can be explained by differences in the carriers' operating conditions, including economies of scale and scope, and the rate of implementing advanced network technologies. Put differently, the management of a mid-sized carrier which through past efforts has been able to achieve relatively low costs of providing services cannot reasonably be expected to obtain the same productivity gains as a larger, higher-cost carrier.

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[2] The contributions of the member companies of each of the holding/operating companies were weighted by their respective revenues.

[3] Our methodology for estimating productivity gains is described in Section III.

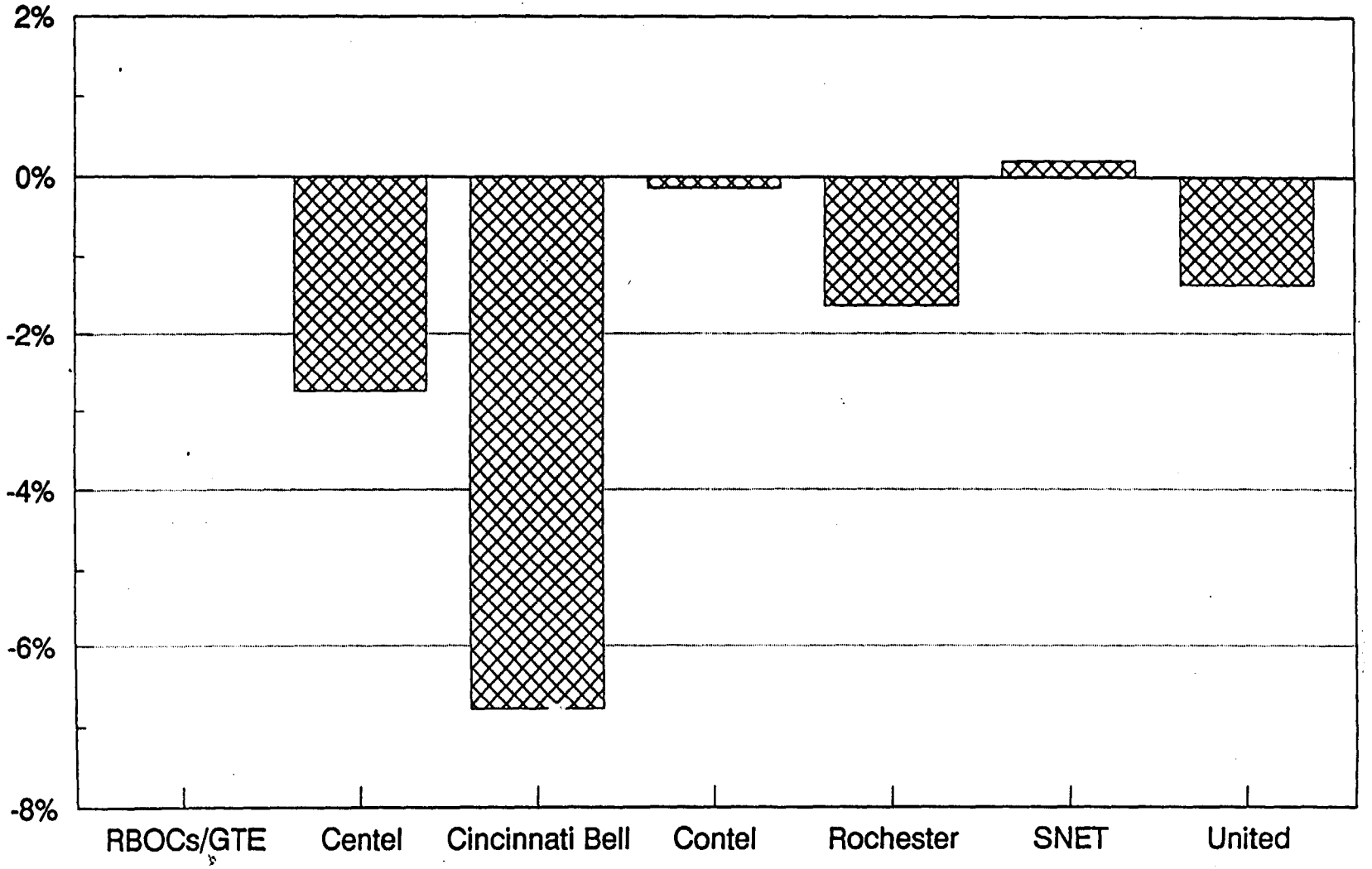
[4] These results apply to *annual* productivity gains. However, as discussed below, the *absolute* cost level of several independents (including Centel) was lower than the BOC/GTE average. The lower level of absolute costs reflects productivity gains already achieved in previous years.

[5] Appendix D of *Supplemental Notice of Proposed Rulemaking* (CC Docket No. 87-313; Adopted March 8, 1990, Released March 12, 1990).

[6] In particular, the exceptionally low productivity gains of Cincinnati Bell during this period may be anomalous. In this regard, see our forecasted productivity gains for Cincinnati Bell (and other LECs) in Section IV.

Average Annual Change in Total Factor Productivity Relative to RBOCs/GTE (1986-1988)

(Percent)



Note: Data for Lincoln Telephone unavailable.

FIGURE 1

n/e/r/a

C. Purpose of This Study

The following analysis has been directed to the end of assisting the Commission in building its record on productivity gains. By examining the productivity differences among companies, we are able to gain insight into whether or not the inherent assumption of similar productivities embodied in the price-cap regulation is reasonable. Analysis of historical detailed statistical data for local exchange companies was undertaken to develop a better understanding of the true drivers of productivity changes.

Previous studies related to the price-cap proceeding have also examined productivity differences *in aggregate* between local and interexchange carriers, and between groups of local exchange companies. In particular, Christensen found that during the pre-divestiture period, productivity of independent telephone companies did not rise as rapidly as that of Bell companies.[7] This result is corroborated by Crandall and Galst for the period 1971 through 1983.[8] However, Crandall and Galst estimate that productivity gains of independent telephone companies exceeded those of BOCs from 1981 to 1988. This last result contrasts sharply with the findings of the present study. A possible reason for the discrepancy is that Crandall and Galst implicitly assume that Bell and independent telephone companies have equal output prices.[9] In reality, the prices of individual independents differ substantially from Bell prices, and there is no reason to think average Bell and independent prices are even approximately equal. Consequently, the Crandall/Galst estimates may involve substantial bias.

A further analysis of productivity differences was conducted by NERA. NERA demonstrated that Cincinnati Bell's productivity gains increased more slowly than that of the BOCs in both pre-divestiture and post-divestiture time periods.[10] However, none of these previous studies examined the specific causes of differences in productivity gains among individual companies. Therefore, the present analysis offers fresh insight into the issue of productivity differences among companies.

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[7] See testimony of Laurits R. Christensen in *United States v. AT&T*, Civil Action No. 74-1698 (D.D.C.), Defendant's Exhibit D-T-128.

[8] See Robert W. Crandall and Jonathan Galst, "Productivity Growth in the U.S. Telecommunications Sector: The Impact of the AT&T Divestiture," November 1990.

[9] Our methodology, based on physical output measures, makes no such assumption.

[10] *Incentive Regulation and Estimates of Productivity*, a study prepared for Cincinnati Bell Telephone Company, NERA, June 9, 1989.

II. MODEL

A. Approach

By using regression analysis of the dependent variable—productivity gains—on various intuitive determinants of productivity gains, we are able to test hypothesized relationships using empirical information. The model is developed by testing several productivity factors to arrive at a robust explanatory relationship. Once the prime determinants of productivity gains are specified, we are then able to analyze whether those factors can be expected to vary considerably across members of the LEC class for which price-cap parameters will be the same. In effect, we seek to identify the variables and coefficients for the equation:

$$\Delta TFP = a + b_1x_1 + b_2x_2 + b_3x_3 \ldots\ldots$$

where;

ΔTFP = Gain in Total Factor Productivity, and

a = intercept

$x_1, x_2, x_3, \ldots\ldots$ are determinants of productivity

B. Dependent Variable (ΔTFP)

The dependent variable which we explain with the model is the annual productivity gain or loss experienced by the individual companies. Productivity gain is defined precisely in Section III.B. It is essentially the excess (or shortfall) of the percentage change in outputs over the percentage change in inputs (after adjustments for price changes).

C. Candidate Independent Variables

Because the particular determinants of the productivity gains are unknown at the outset of the modeling process, several different intuitive explanatory factors were tested in developing the model. Most of these variables have been the focus of previous discussions of productivity factors. Each of the tested factors, and the justification for their consideration, are discussed in turn below.

1. Holding Company Size

As the size of the holding company increases, it may be expected to yield economies of scale, which would translate into increased productivity. Because growth in productivity would not be expected to increase linearly with size (for large differences in size), the natural logarithm of the holding company size was included as the regressor. This variable is illustrated for various companies in Figure 2. We measure holding-company size in terms of access lines. Data on other measures of carriers' size, such as access lines per study area or exchange, were not available on all the companies in the sample.

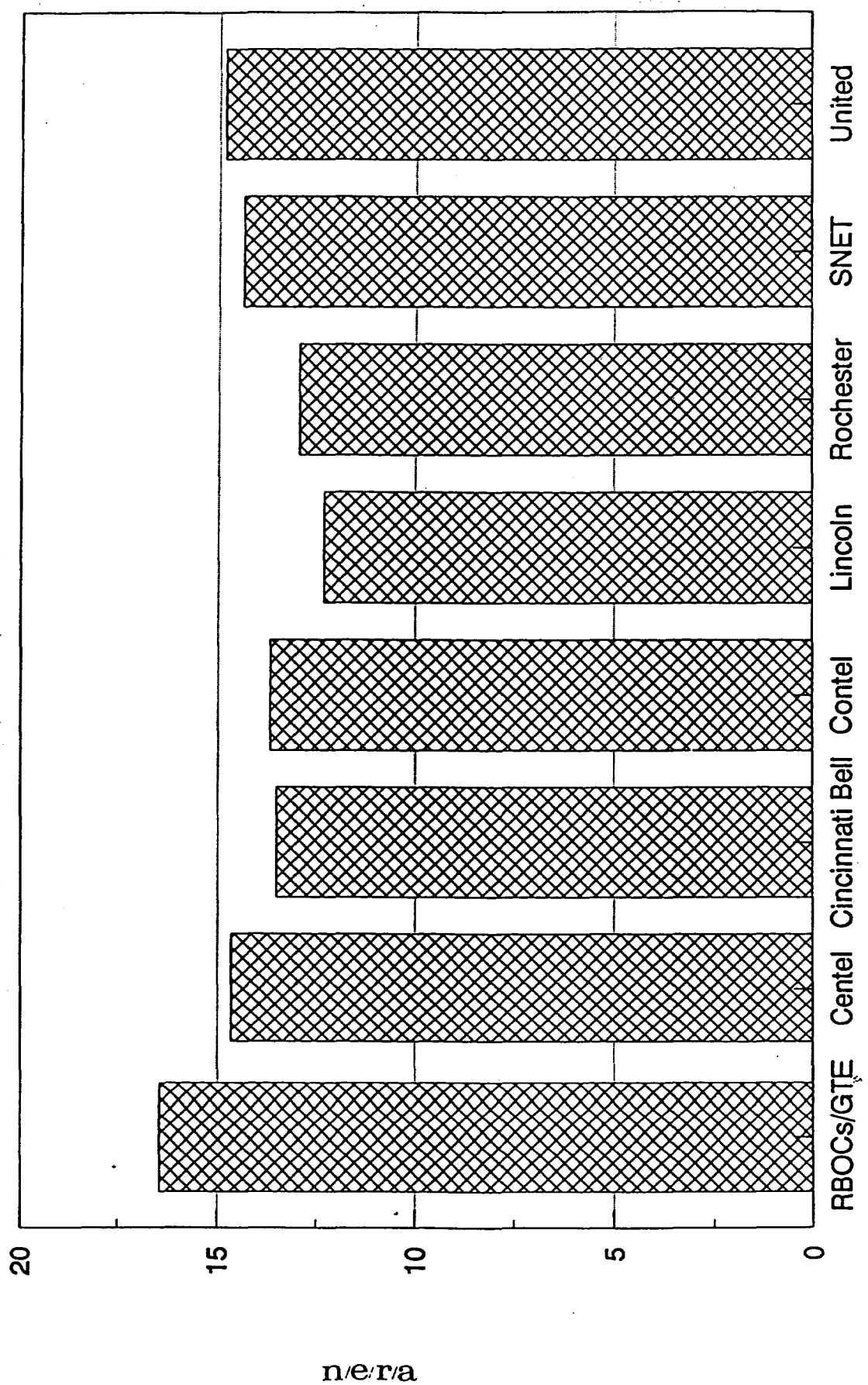
2. Cost Level

Inclusion of a cost variable is based on the simple premise that, if a company starts out with a lower cost level, its opportunity for (further) cost reductions (productivity improvements) is reduced. Therefore, high-cost companies may exhibit greater productivity gains than lower-cost companies. Factors affecting the cost level of a firm include the number of digital switches and the age of the plant. Digital switches, while initially requiring capital expenditures, lead to realized savings after installation. Similarly, newer plant affords costs savings through operating efficiency and improved technology, although originally incurring capital expenditures. The cost index used is defined precisely in Section III.B.

Figure 3 shows average costs of various independents relative to the BOC/GTE average. Comparing this figure with Figure 1, we observe that the three companies with lowest cost (Centel, Rochester and Cincinnati Bell) are precisely the three companies with the lowest annual productivity gains.[11] This suggests that the rationale for including costs in the ΔTFP equation is sound; and, indeed, costs do turn out to be statistically significant.

[11] As discussed further below, Centel has the lowest unit cost of any holding company in our sample. Lincoln Telephone has low costs, but because data are lacking, we were unable to estimate Lincoln's productivity gains. We note, however, that Lincoln elected not to go under price caps. This suggests that Lincoln does not expect especially large productivity gains in the future.

FIGURE 2


Average Log of Holding Company Size
(Log Revenues)
20
15
10
5
0
RBOCs/GTE
Centel
Cincinnati Bell
Contel
Lincoln
Rochester
SNET
United
n/e/r/a

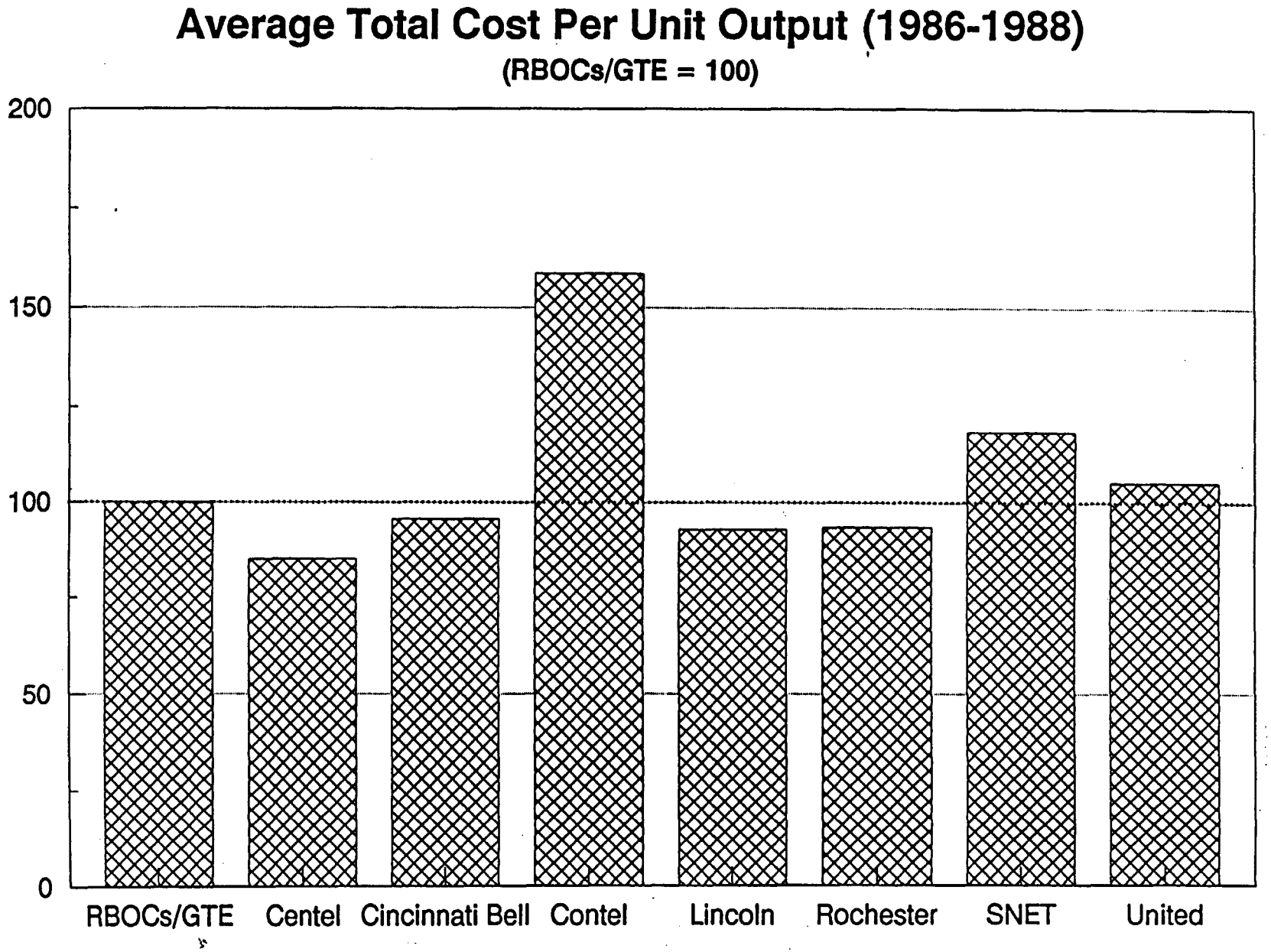


FIGURE 3

3. Time Effects (Fixed)

A fixed effect variable for each successive year in the time period analyzed accounts for variables which may be missing from the model specified. Using this approach averts bias due to the missing variables to the degree that the variables cause equal productivity gains across all companies for a given year. Because the data are pooled (both cross-company and time-series data points are used), including time-specific variables still affords sufficient degrees of freedom to support a robust model. This mechanism accounts for important differences across time periods (such as changes in accounting rules) which are not captured in the other variables, but which may affect measured productivity gains and should be accounted for in the model.[12]

4. Percent Digital/Electronic Equipment

Companies with older-technology switching equipment can improve productivity by installing state-of-the-art digital-switching equipment. Digital switching affords savings by reducing maintenance costs, labor costs, and by promoting operating efficiency. Companies which have already modernized their equipment have less opportunity for productivity improvements by updating switching equipment. As indicated above, the savings that result from deployment of digital equipment are also reflected in the cost level.

Digital share was measured as digital investment divided by total switching investment. This measure is not ideal, since it is affected by past equipment prices and depreciation practices. The measure was chosen because of the availability of data. Data on access lines served by digital switches were not available during the early part of the sample period.

5. Age of Plant

Companies with older average plant can improve productivity by modernization of their plant. Companies that have already modernized have less opportunity to do so. (This is a more general assessment of the same phenomena modeled in No. 4 above.)

6. Growth Rate

Because the cost of serving new demand may differ from that of serving existing demand, a higher growth rate, precipitating a different ratio of existing to new demand, could

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[12] Since the model accommodates accounting changes in this indirect manner, it does not yield estimates of absolute productivity gains isolated from any accounting changes. However, the model does yield consistent estimates of relative productivity gains among companies in any given year.

yield a different productivity rate. The growth rate is defined as the percentage increase in the output index.

7. Usage per Access Line

Minutes of use and number of access lines are both outputs. Because the mix of these two outputs may vary, and the productivity associated with each of the outputs also may vary, productivity may differ where the mix is other than the average (where there is heavier or lighter usage per access line).

8. Significance of Candidate Variables

The first three variables (holding-company size, cost level and fixed time effects)[13] were statistically significant, and they are included in the final equation. The remaining variables (digital share, age of plant, growth rate and usage per access line) were not statistically significant, and they are not included in the final equation. As discussed below, the effects of digital share and age of plant may be incorporated in the cost-level variable. The other two variables (growth rate and usage per access line), though plausible determinants of productivity, did not significantly contribute to explaining productivity differences in our sample.

[13] Fixed time effects actually consist of two regression variables.

III. DATA

A. Data Series and Sources Used

Data for our analyses were drawn primarily from *Statistics of Communications Common Carriers*[14] which reports telephone company financial and operating data taken from annual reports filed by the carriers with the FCC. We collected a large subset of these data. Some of the data were used directly, while others were used to calculate derived variables. Data were actually used for a total of 43 companies, including 21 Bell Operating Companies and 22 independent companies. Annual data were used for 1986[15] to 1989 so we could model annual productivity changes between 1986 and 1987, 1987 and 1988, and 1988 and 1989. In some cases, companies operated for only part of this time period, and then became part of another entity through reorganization.[16] Data for each entity were compiled and analyzed for the years of the entity's operation. Because certain companies had gaps in the data, not all data were used in the analysis. Additionally, some observations were deleted on the basis of extreme, inexplicable data irregularities. All data were converted to real terms, by adjusting for inflation in each year.

Information on the following holding/operating companies was included: Ameritech, Bell Atlantic Corporation, BellSouth Corporation, NYNEX, Pacific Telesis Group, Southwestern Bell Corporation, US West Communications, Cincinnati Bell Telephone Company, Southern New England Telephone Company, Contel Corporation, GTE Corporation, Lincoln Telephone & Telegraph Company, Rochester Telephone Corporation, United Telecommunications, Inc. and Centel Corporation.

There were 37 observations for the year 1986, 39 observations for the year 1987, and 40 observations for the year 1988.

B. Definition of Variables

1. Measures of Productivity

Productivity gain is the excess of the change in output over the change in input factors. In other words, it is a measure of efficiency of production, represented by a change

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[14] FCC, *Statistics of Communications Common Carriers*, for years ending 1984 through 1987: Tables 14 and 15; for years ending 1988 through 1989: Tables 2.9 and 2.10.

[15] Data from 1984 were not used directly in the analysis due to data irregularities in that year. Insufficient consistent data were available for 1985 to support analysis for that year.

[16] For example, General Telephone (GTE) of Ohio became part of GTE North in reporting year 1987. Therefore, the partial data series for GTE Ohio is treated as a separate entity in the analysis.

in the number of units that can be produced for a constant cost. Productivity gain is the same as a change in the per-unit cost of production, assuming input costs remain constant. To model productivity gain, the model must isolate the change in per-unit cost which results from any change in productivity rather than resulting from a change in costs of inputs (e.g., a rise in cost of capital). Reductions in input costs do *not* generally reflect more efficient operation, but rather, are a change in cost largely beyond the control of the firm. Therefore, in order to isolate effects of productivity on unit cost from input factor influences on unit cost, we control for changes in input costs by using price indices for the inputs of labor, capital, and material costs for each year in the series, and accounting for the proportion of each expended by the individual companies.

a. Output price index .

Specific data on output price indices were not available. Identifying particular changes in output costs for each of the companies for each year would require extensive research into rate case filings, and was outside the scope of this effort.[17]

b. Output quantity index

Due to the difficulty of obtaining a consistent series of price index data, we could not use deflated revenues as our output quantity index. Data on physical output quantities were used instead.

Gain in Total Factor Productivity can be derived by the difference between proportional changes in quantity and the proportional change attributable to price of inputs, or:

$$\Delta TFP = \frac{\Delta Quantity\ Produced}{Quantity\ Produced} - \frac{\Delta Quantity\ Input}{Quantity\ Input}$$

[17] Crandall and Galst, *op. cit.*, used aggregate data on telephone prices and implicitly assumed that prices of all telephone companies were equal. As previously discussed, that assumption is indefensible and we therefore rejected the Crandall/Galst approach. Crandall/Galst focused primarily on productivity changes over time, and the use of aggregate prices may be appropriate for that purpose. Such use of aggregate prices is, however, wholly inappropriate for analyzing productivity differences among telephone companies.

c. Quantity produced

Quantity data were available on the two primary outputs of each telephone company: (1) access lines, and (2) usage (number of minutes of traffic).[18] Although greater accuracy may be provided by including additional components of output besides these two measures, such information was not readily available. Secondly, although access lines and usage are only two among several elements that constitute total output of the LECs, they are the primary outputs. Finally, the fixed time *effects* variables (previously discussed) control, at least in part, for the effects of other outputs which are not measured directly in the equation.

To measure access lines and usage, the following data were collected: number of access lines and total dial equipment minutes,[19] by year and by company. Dial equipment minutes reflect both access and local calls. They also reflect the more intensive use of switching equipment by certain calls, providing a better measure of actual output represented by processing those calls. The output index used is a weighted average of these two primary outputs.

Estimates of the marginal cost were used to weight the access and usage proportions of the output in this model. The alternative of weighting by revenue share was considered, as revenue (reflecting price) may be appropriate for a competitive marketplace.[20] However, in a regulated industry, such as local telephone service, price may not accurately reflect actual marginal cost. Therefore, direct estimates of marginal cost were used for this analysis.

The relative marginal costs of access and usage were estimated in a study by Perl and Falk[21] filed by the United States Telephone Association (USTA) in the price-cap

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[18] The use of only two outputs in this calculation is analogous to using only two quantity variables—access lines and usage—in a cost model.

[19] Both sets of data were taken from the Federal-State Joint Board *Monitoring Report* (CC Docket No. 87-339, January 1991, Tables 4.6A and 4.12A.)

[20] Because revenue reflects prices, the ratio of access and usage prices can be used as a surrogate for the ratio of aggregate marginal costs in the sample. This measure contains the implicit assumption that prices are proportional to marginal costs.

[21] Lewis Perl and Jonathan Falk, *The Use of Econometric Analysis in Estimating Marginal Cost*, (Presented at Bellcore and Bell Canada Industry Forum: San Diego, California), April 6, 1989.

proceeding (CC Docket 87-313) in 1989.[22] The Perl/Falk study estimated marginal costs econometrically on pooled time-series cross-section data collected on 39 companies[23] over 1984 through 1987. The implicit assumption in this measure is that the ratio of access marginal cost to usage marginal cost is the same for all companies and all time periods. Marginal costs are estimated at $300 per access line, and $0.01 per minute usage.

The precise formula used to determine the change in quantity produced is as follows:

$$\frac{(Growth_{loops}*Number_{loops}*MC_{loops}) + (Growth_{minutes}*Number_{minutes}*MC_{minutes})}{(Number_{loops}*MC_{loops}) + (Number_{minutes}*MC_{minutes})} - 1$$

where;

$Growth_{loops}$	=	Growth rate for telephone loops
$Number_{loops}$	=	Number of telephone loops
MC_{loops}	=	Annual Marginal Cost of telephone loop ($300)
$Growth_{minutes}$	=	Growth rate for minutes of usage
$Number_{minutes}$	=	Number of minutes of usage
$MC_{minutes}$	=	Marginal Cost of minute of usage ($0.01); or $10,000 per million minutes of usage

This formula provides a measure of the growth or shrinkage in output.

d. Quantity of input

Changes in input quantities are calculated by examining the *real* change in input expenditures (obtained by adjusting expenditures for shifts in price that serve to change expenditure but not in quantity). Subtracting the changes in price of inputs removes effects that are attributable to shifts in factor prices, rather than increased input quantity. Expenditures for each of the three input factors—capital, labor and material—are adjusted for price changes and multiplied by the respective contribution to overall input expenditures. The summation of the total reflects growth (or shrinkage) in total input quantity which must be subtracted from the growth in total output quantity to reveal changes in efficiency. The precise formula used to measure changes in quantity of input factors is as follows.

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[22] "Analysis of AT&T's Comparison of Interstate Access Charges Under Incentive Regulation and Rate of Return Regulation," prepared by NERA, July 24, 1989.

[23] 24 Bell and 15 non-Bell companies.

$$(Growth_{cap\ exp} - Growth_{cap\ price}) * (Cost_{cap}/Cost_{tot})$$
$$+$$
$$(Growth_{labor} - Growth_{labor\ price}) * (Cost_{labor}/Cost_{tot})$$
$$+$$
$$(Growth_{mat\ exp} - Growth_{mat\ price}) * (Cost_{mat}/Cost_{tot})$$

where;

$Growthcap_{exp}$	= Growth rate for capital expense
$Growth_{cap\ price}$	= Growth rate for capital price
$Cost_{cap}$	= Capital expense
$Cost_{tot}$	= Total cost
$Growth_{labor}$	= Growth rate for labor expense
$Growth_{labor\ price}$	= Growth rate for labor price
$Cost_{labor}$	= Labor expense
$Growth_{mat\ exp}$	= Growth rate for material expense
$Growth_{mat\ price}$	= Growth rate for material price
$Cost_{mat}$	= Material expense

2. Sources for Measures of Input

The exact components of the variables used in the formula for changes in input quantity are discussed below:

a. Cost indices

1) Material expenses

Total operating expenses (as reported) less total compensation[24] less total depreciation and amortization expense. (Taxes are not part of materials expense and are not included in operating expenses).

[24] Compensation data were taken directly from company annual reports provided by the FCC.

2) Capital costs

Capital costs equal capital stock multiplied by the price of capital. Capital stock was calculated as follows: the prior year's capital stock[25] was multiplied by the annual change in the TPI and one minus the predicted depreciation rate. Added to this result was new investment, yielding a running total of the replacement cost of the capital stock. New investment is the change in plant in service plus retirements. Retirements were estimated as depreciation and amortization expense less the annual change in cumulative depreciation and amortization.

3) Labor expenses

Labor expenses were taken directly from company annual reports filed with the FCC.

4) Total cost

The formula used to calculate total cost was: labor expenses plus material expenses plus capital costs. Total costs also equal total operating expenses minus total depreciation and amortization expense plus capital expenses.

b. Price indices

1) Price of labor

The index was based on state-specific, average annual wage in the transportation, communications and public utilities industries.[26]

2) Price of materials

The fixed-weighted price index for gross national product (GNP-PI) was used.[27]

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[25] For the initial year, the previous year's capital stock is a deflated value of the total plant in service, or the economic value. The deflator equals the following:

$$\alpha_t = \frac{\sum_{j=0}^{20}(1+\Delta)^{t-j}(1-\delta)^j}{\sum_{j=0}^{20}(1+\Delta)^{t-j}TPI_{t-j}}$$

where Δ equals the company's average annual growth in loops and δ equals the company-specific depreciation rate.

[26] Data were downloaded from Data Resources, Inc.

[27] Data were downloaded from Data Resources, Inc.

3) Price of capital

The price of capital includes the sum of the risk-free rate plus a risk premium. The Treasury Bill rate[28] was used to estimate the risk-free rate. The risk premium was estimated at 3 percent, which is roughly consistent with the Commission's calculated cost of capital. To this sum is added the predicted depreciation rate[29] and the predicted tax rate,[30] less the annual growth in Total Plant Index (TPI).

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[28] The 10-year composite rate for U.S. Treasury notes and bonds. Figures were taken from *Federal Reserve Bulletin* (Board of Governors of the Federal Reserve System, Washington, D.C., December 1986, July 1990, October 1990, Table 1.35, p. A24.).

[29] Company-specific average, over all years, of the reported depreciation expenses divided by net plant. Net plant equals the reported total plant less total depreciation and amortization.

[30] Predicted in a similar manner to the depreciation rate, but accounting for tax reforms which occurred after 1986. Predicted tax rate was based on a regression of the reported tax expense over the net plant on company indicator variables plus a 1987 and post-1987 indicator to account for the declining tax rates.

IV. STATISTICAL RESULTS

Several of the candidate independent variables proved to be insignificant in the regression analyses, and were excluded from the final models. In particular: the share of digital equipment, the age of plant, usage per access line, and growth rate were all were excluded. Notwithstanding their exclusion, digital share and age of plant do enter the equation indirectly, since the savings that result from deploying state-of-the-art equipment are reflected in the cost level.

A. Final Model: Productivity as a Function of Holding Company Size, Cost Level and Operating Year

The equation which best explained the changes in productivity is as follows:

$$\Delta TFP = -0.1236 + 17.48x_{\text{cost index}} + 0.007821\, lnx_{\text{hcsize}} - 0.0900x_{1987} - 0.0469x_{1988}$$

where;

ΔTFP	=	Gain in Total Factor Productivity
$x_{\text{cost index}}$	=	Estimate of Cost Level (total cost per unit output); Total Cost/(Marginal $Cost_{lines}$*Q_{lines} + Marginal $Cost_{usage}$*Q_{usage})
lnx_{hcsize}	=	Log of size of the holding company (measured in access lines)
x_{1987}	=	Fixed effect for the year 1987
x_{1988}	=	Fixed effect for the year 1988

1. Statistical Fit

r^2: 0.61

r^2_{ADJ}: 0.59

MSE_{root}: 0.0315

F Value: 43

t Statistics:

$x_{\text{cost index}}$:	1.8
lnx_{hcsize}:	2.8
x_{1987}:	-12.3
x_{1988}:	-6.5

All the estimated coefficients are significantly greater than or less than zero at the 5-percent level (one-tailed test).

2. Interpretation of Results

The statistical relationship developed in the model indicates that the primary determinants of productivity gains are the size of the holding company and the cost level per unit of output. The size of the holding company had a large effect on productivity gains, encompassing the effects of any economies of scale which may have been achieved. For example, the model indicates that, if Company A is twice the size of Company B, Company A's productivity change will exceed that of Company B's by 0.54 percent per year.[31] The profound effect of the cost index is intuitive because a firm which is operating at above average costs to start with would be most easily able to experience productivity gains by cutting costs and increasing efficiency of operations. For example, if Company A has an average cost level for producing output, and Company B's cost level is 10 percent below average, Company A's productivity change can be predicted to exceed that of Company B by 0.24 percent per year. This effect tends over time to reduce differences in productivity gains among companies, but the effect is very slow. The expected annual difference in productivity gain is only 2.4 percent of the original difference in unit costs. Nevertheless, expected annual productivity gains are *substantially* less for low-cost companies, such as Centel, than for higher-cost companies.

3. Individual Company Forecasts

Using the model developed, it is possible to forecast what the expected productivity gains for each firm examined will be. The forecast values reflect the latest specific effects—the 1988 time-specific effect, 1988 cost level and the 1988 holding company size. Table 1 reflects the forecasted total factor productivity changes relative to the composite Bell/GTE average:[32]

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[31] This is calculated as the product of the estimated coefficient (0.007821) and *ln* 2 (0.6931).

[32] Composite average is weighted by revenues of individual companies contributing to the average.

TABLE 1 TFP CHANGES	
Holding Company	TFP Forecasted Change Relative to Bell/GTE Average
Bell/GTE Average	0.0%
Cincinnati Bell	-2.3%
Southern New England Telephone	-1.2%
Contel	-0.8%
Lincoln	-3.5%
Rochester	-2.8%
United	-1.0%
Centel	-1.5%

Figure 4 provides a graphical display of the difference in forecasted change in total factor productivity by LECs other than Bell or GTE from the mean change in total factor productivity by the Bell/GTE composite average for 1986 through 1988. The results indicate that the non-Bell/GTE LECs are all likely to experience less productivity growth than will the Bell/GTE average.

The ordering of our forecasts is generally consistent with the decisions that carriers have actually made with regard to price caps. Companies whose expected productivity gains are within 1.2 percent per year of the BOC/GTE average (United and SNET) have elected price caps.[33] This also applies to Contel, though price caps are mandatory for Contel as a result of its acquisition by GTE. The expected productivity gains of Centel, Cincinnati Bell and Lincoln are all at least 1.5 percent per year less than the BOC/GTE average. These companies have declined to go under price caps. The one anomaly in this analysis is Rochester, which elected to go under price caps even though its expected productivity gains are 2.8 percent per year less than the BOC/GTE average.

[33] These companies may or may not profit as a result of their decision to elect price caps. In any event, our analysis suggests that they are unlikely to do as well under price caps as the larger LECs.

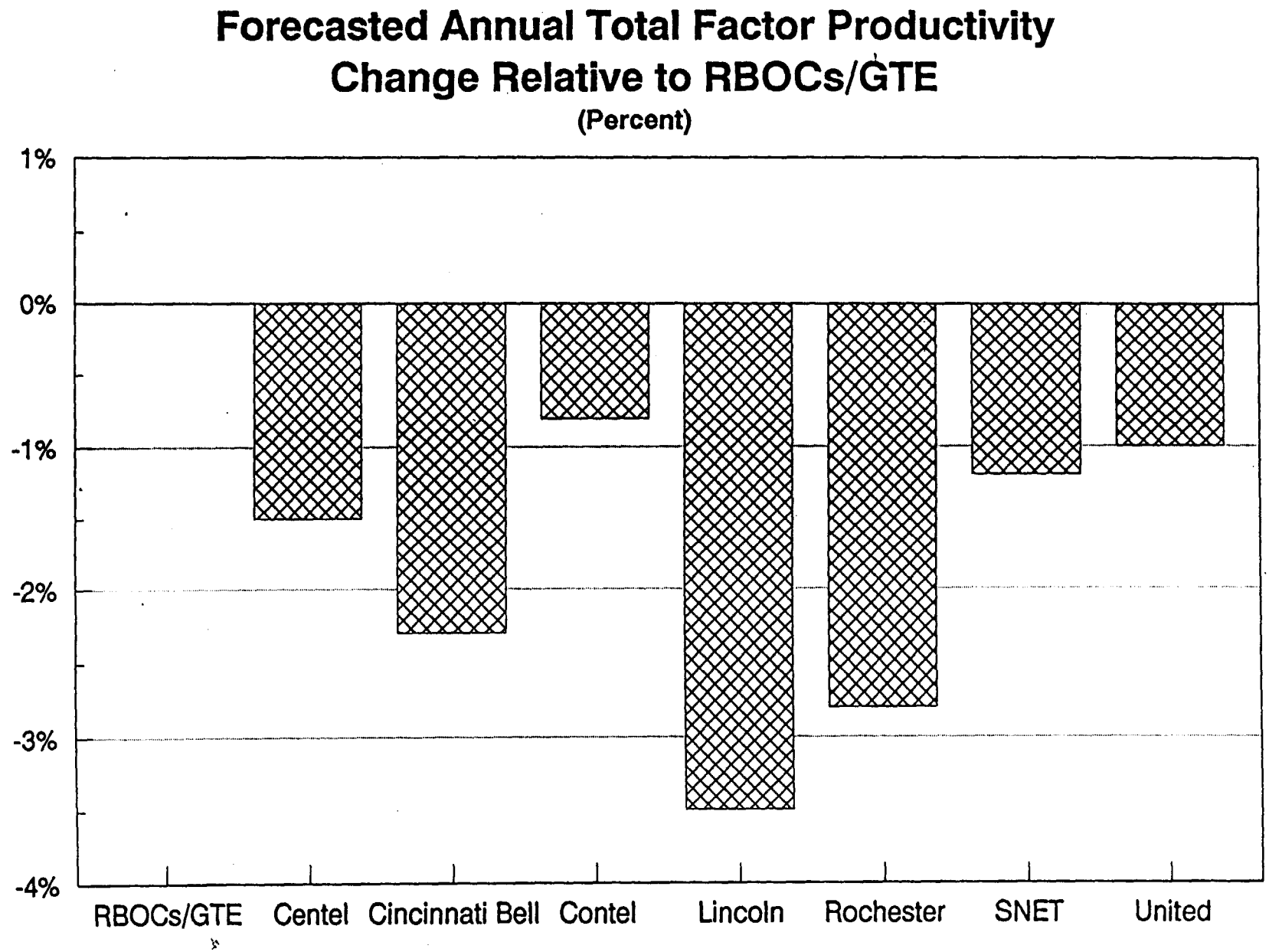
Forecasted Annual Total Factor Productivity
Change Relative to RBOCs/GTE
(Percent)
1%
0%
-1%
-2%
-3%
-4%
RBOCs/GTE
Centel
Cincinnati Bell
Contel
Lincoln
Rochester
SNET
United

FIGURE 4

V. IMPLICATIONS FOR PRICE CAPS

The quantitative analyses of this study indicate that the size and level of costs of a telephone company cause statistically significant variations in expected productivity gains. The method of rate regulation should not penalize companies because of their relatively small size or because of their past successful efforts to reduce their costs, such as through aggressive implementation of digital technologies.

In the context of price-caps plans, the FCC and state commissions should adopt different productivity adjustments for different carriers, or at least for several different groupings of carriers. Smaller, lower-cost carriers should have a substantially lower productivity adjustment than the level applied to the BOCs and GTE. This study estimates a reasonable productivity adjustment for Centel that is 1.5 percentage points below that of the BOCs and GTE.

A single productivity adjustment applicable to all carriers fails to maximize the effectiveness and reasonableness of the price-caps method of rate regulation. The FCC has allowed (and state commissions may allow) carriers such as Centel to choose to have their rates regulated by a price-caps plan where the productivity adjustment was developed from analysis of the BOCs and GTE or an industry average. The statistical analysis of this study indicates that such carriers would likely earn unreasonably low returns under such a plan. Smaller, lower-cost carriers may reasonably choose to be subject to the traditional method of rate regulation instead of such a price-cap plan.

Another method of rate regulation ("shared earnings" or "banded rate of return" plans) establishes a zone of earnings that a carrier can retain without partial or full refunds to ratepayers. These plans should reflect the fact that productivity gains can be more easily achieved by larger, higher-cost carriers than by smaller, lower-cost carriers. A level of productivity gains yielding, for example, earnings 200 basis points above some prescribed level may represent above-average efforts by a larger, higher-cost carrier. But, the same level of productivity gains and earnings would correspond to truly extraordinary efforts by a smaller, lower-cost carrier. In order to match rewards to accomplishments, the zone of potential retained earnings for smaller, lower-cost carriers should be higher (more potential for retained earnings) than the zone for larger, higher-cost carriers.

Finally, this study also has important implications for cost-plus methods of rate regulation. Traditional rate-base/rate-of-return regulation incorporates the concern about reasonable productivity gains in determining whether particular investments and expenses are

"imprudent" or not "used and useful," or whether overall cost levels are "excessive." In these determinations, regulators frequently use other carriers' performance as bench marks. This study finds that a shortfall in the productivity gains by a mid-sized, lower-cost carrier when compared against larger, higher-cost carriers can reasonably be expected in light of their differing operating conditions. If such a shortfall appears, it should not be taken as evidence that the smaller, lower-cost carrier is inefficient or poorly managed.